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EDITORIAL ANNOUNCEMENTS.

THE BRITISH AND EASTERN CONTINENTS edition of the Railroad Gazette is published each Friday at Queen Anne's Chambers, Westminster, London. It contains selected reading pages from the Railroad Gazette, together with additional British and foreign matter, and is issued under the name Railway Gazette.

CONTRIBUTIONS.—Subscribers and others will materially assist in making our news accurate and complete if they will send early information of events which take place under their observation. Discussions of subjects pertaining to all departments of railroad business by men practically acquainted with them are especially desired.

ADVERTISEMENTS.—We wish it distinctly understood that we will entertain no proposition to publish anything in this journal for pay, EXCEPT IN THE ADVERTISING COLUMNS. *We give in our editorial columns* OUR OWN *opinions, and these only, and in our news columns present only such matter as we consider interesting and important to our readers. Those who wish to recommend their inventions, machinery, supplies, financial schemes, etc., to our readers, can do so fully in our advertising columns, but it is useless to ask us to recommend them editorially, either for money or in consideration of advertising patronage.*

OFFICERS.—In accordance with the law of the state of New York, the following announcement is made of the office of publication, at 83 Fulton St., New York, N.Y., and the names of the officers and editors of The Railroad Gazette:

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VOL. XLIV., No. 14. FRIDAY, APRIL 3, 1908.

RECENT ELECTRIFICATION WORK.

It has been the practice at the New York Railroad Club for the past few years to devote one meeting of each season to the discussion of electrical matters, especially along the lines of the electrification of railroads that are or have been operated by steam. These meetings have invariably called out a large attendance and have been marked by a much more conservative estimate of the advantages accruing from electrification than has characterized the gatherings where the subject has been discussed by electrical engineers only. The evening of March 20 was devoted to this subject and was no exception to those that had preceded it.

As in the development of any other great work, it is at the point of realization that extravagance of statement and of claims ceases and the promoters are willing to let the results rest upon their merits. At present, as one speaker pointed out, conditions have reached such a point of perfection, and such great works have been executed, that it is merely necessary to refer to them to confirm a proposition. Previous work has been so well done that it has not been found necessary to introduce any very radical changes or improvements on what has been done before in the developments of the last year. Not that the last word has been said, or that, in the installations that have been completed, there has been no trouble—there have been endless annoyances and unlooked for difficulties that have made the lot of the engineers anything but a happy one. But these difficulties have been those of detail and not of fundamentals and principle, so that the way out is clear, and the means of avoiding similar ones in the future are measurably plain. Further than this, work has been carried to such a point that the operation of electric trains of the first-class calls for higher development of power than that in use on heavy traffic high speed steam-operated lines. The Interborough of New York was cited as an instance where, in the subway section, trains were equipped with motors aggregating 2,000 h.p., while for surface work on the electric zone of the New York Central 1,600 h.p. was provided in a single locomotive. The concentration of high powers is, therefore, no longer a thing of promise but an accomplished fact.

In the course of the discussion, with no set paper as a center, and with each speaker acting as a free lance, the old argument was again presented, to the effect that where such great improvements were made as in the case of the New York Central and Pennsylvania works in New York, if it is desired to compare the costs of steam and electric operation, the whole cost should not be charged to the latter, but the estimate should be based on what it would cost to provide for the same service with steam that will be rendered by the electric equipment. Attention was also called to the increased value of the "air" rights when electric operation is provided for. That is to say, in the construction of terminals it becomes possible to build large and high office buildings immediately above the tracks and thus utilize space that would be useless and valueless were steam to be used, with its accompaniment of smoke and gas.

Viewed, then, in the light of present achievement, the electrical engineer need not anticipate that he will have any more difficult problems to solve than those which have already been presented. They will differ, of course, for different conditions will require different solutions, and each installation of an electric plant will have to be governed by local surroundings in the future just as it has in the past. As for the cost of installation and operation, the speakers had little to say. The presentation of possibilities had already been made and it was upon the expectation that these would be fulfilled that much of the present-day work had been undertaken. Some of these installations were now working out their own salvation, and they promised well for the fulfillment of the prophecies that had been made regarding them. At any rate, they will now be judged solely on their merits, without extravagance of claim.

With the demonstrations that have been made, the electrical engineer is in a position to undertake any project that may be presented. Not all these projects will offer the inducements of commercial success, but when this is assured it is then merely a question of money to secure the plant. The electric traction engineer has the choice of five systems: the third rail, single-phase, three-phase, 1,200 volt direct current and gasolene-electric car.

This was the trend of the discussion, and it differed very materially from that of previous meetings, since it was a recital of

things done rather than of claims for future possibilities. It was in view of this array that one speaker expressed surprise that the list of great works done or under consideration was not larger, but attributed it to the great first cost of many of the enterprises that had been proposed. Reduction of first cost is going to be the biggest problem confronting electrical engineers in the immediate future.

As for the great works that have been either completed or decided upon, the array is certainly imposing. There is the electrification of the New York Central and of the New Haven, with its base at the Grand Central Station of New York; the Pennsylvania's terminal well under way; the opening of the extension of the subway beneath the East river to Borough Hall, and the tunnel under the Hudson to Hoboken, with the probability of others to Long Island and Jersey City in the near future. Then there is the electrification of the Rochester branch of the Erie and of the West Shore between Utica and Syracuse; the Cascade tunnel of the Great Northern, and the line over the Bitter Root mountain on the Pacific coast extension of the Chicago, Milwaukee & St. Paul, over which heavy trains are to be hauled on a 1.7 per cent. grade, with a current generated by water power. Yet, with all these possibilities and probabilities of the future, there was not a word in the discussion regarding the demise of the steam locomotive, but it was stated that when the youngest man in the room was old and gray headed the steam locomotive would still be at work, and an estimate was made that if all the electrical manufacturing concerns in the country were to devote themselves exclusively to building electric locomotives for the next twenty years they would not, at the end of that time, have built as many as the number of the steam locomotives now in use.

The meeting was interesting, not only from the statements that were made regarding the achievements of the past year and the absence of all extravagance of claim, but as an exemplification of that broadness of vision that has come to the electrical engineer as the result of his contact with the steam engineer and his increased familiarity with the problems presented by heavy traffic, high-speed work.

HIGH STEAM PRESSURES IN LOCOMOTIVE SERVICE.

The Carnegie Institution of Washington has issued a book of about 140 pages containing the results of the experiments conducted by Prof. W. F. M. Goss at Purdue University on the high steam pressures in locomotive service. As is usual in the documents coming from this authority, the work is of the highest value as indicating the limitations of commercially profitable pressures in locomotive practice. In the summary of his conclusions the author shows that, as there is an increase of boiler pressure, there is a decrease in the amount of water consumed per indicated horse power, and this same statement holds in the item of fuel consumption also. This would lead to the natural conclusion that the higher the pressure the more economical the operation. This is not, however, necessarily the case, as was so admirably shown at the meeting of the Master Mechanics' Association last year. As the pressure is increased the saving does not increase in the same ratio, being less for the same increments of higher pressure. Then, too, even that saving that has been indicated "depends upon the degree of perfection attending the maintenance of the locomotive," and the values obtained assume a high order of maintenance. If this is lacking, it may easily happen that the saving which is anticipated through the adoption of higher pressures will entirely disappear. The difficulties to be met in the maintenance both of boiler and of cylinders also increase with increase of pressure.

Dean Goss' results supply an accurate measure by which to determine the advantage of increasing the capacity of a boiler. For the development of a given power, any increase in boiler capacity brings its return in improved performance without adding to the cost of maintenance or opening any new avenues for incidental losses. As a means to improvement, it is more certain than that which is offered by increase of pressure.

As a scale of pressure is ascended, an opportunity to further increase the weight of a locomotive should in many cases find expression in the design of a boiler of increased capacity rather than in one for higher pressures. Assuming 180 lbs. pressure to have been accepted as standard, and assuming the maintenance to be of the highest order, it will be found good practice to utilize any allowable increase in weight by providing a larger boiler rather than by providing a stronger boiler to permit higher pressures. Wherever the maintenance is not of the highest order, the standard running pressure should be below 180 lbs. Wherever the water, which must be used in boilers, contains foaming or scale-making admixtures, best results are likely to be secured by fixing the running pressure below the limit of 180 lbs.

A simple locomotive using saturated steam will render good and efficient service when the running pressure is as low as 160 lbs.; under most favorable conditions, no argument is to be found in the economic performance of the engine which can justify the use of pressure greater than 200 lbs. The early tests were made with the first locomotive on the plant, but the pressures were limited to a maximum of 150 lbs. and the results are given in Prof. Goss' book on Locomotive Performance which was reviewed in the *Railroad Gazette* of May 3, 1907. In the new series the work was done at pressure of 240, 220, 200, 180, 160 and 120 lbs., a range which extends far below and far above pressures which are common in present practice.

As for the difficulties of operating under high pressure, the work with the experimental locomotive has shown that those difficulties which, in locomotive operation, are usually ascribed to bad water, increase rapidly as the pressure is increased. The water supply of the Purdue laboratory contains a considerable amount of magnesia and carbonate of lime. When used in boilers carrying low pressure, there is no great difficulty in washing out practically all sediment. The boiler of the first experimental locomotive, *Schenectady No.* 1, which carried but 140 lbs. and was run at a pressure of 130 lbs., after serving in the work of the laboratory for a period of six years, left the testing-plant with a boiler which was practically clean. Throughout its period of service this boiler rarely required the attention of a boilermaker to keep it tight. Water from the same source was ordinarily used in the boiler of *Schenectady No.* 2, which carried a pressure of 200 lbs. or more. It was soon found that this boiler, operating under the higher pressure, frequently required the attention of a boilermaker. After having been operated for no more than 30,000 miles, cracks developed in the side sheets, making it impossible to keep the boiler tight, and new side sheets were applied. In operating under pressures as high as 240 lbs., the temperature of the water delivered by the injector was so high that scale was deposited in the check-valve, in the delivery pipe, and in the delivery tube of the injector. Under this pressure, with the water normal to the laboratory, the injectors often failed after they had been in action for a period of two hours. The interruptions of tests through failure of the injector, and through the starting of leaks at stay bolts, as the tests proceeded, became so annoying that, as a last resort, a new source of water supply was found in the return tank of the university heating-plant. This water was mostly distilled, and its use greatly assisted in running the tests at 240 lbs. pressure.

Probably some of the difficulties experienced in operating under very high steam-pressures were due to the experimental character of the plant, and would not appear after practice had, by a gradual process of approach, become committed to the use of such pressure, but the results are clear in their indication that the problem of boiler maintenance, especially in bad-water districts, will become more complicated as pressures are further increased. Since, taking the country over, there are few localities where locomotives can be furnished with pure water, the conclusion stated should be accepted as rather far-reaching in its effect.

The tests developed no serious difficulties in the lubrication of valves and pistons under pressure as high as 240 lbs., though this could not be done with a grade of oil previously employed. With increase of pressure any incidental leakage, either of the boiler or from cylinders, becomes more serious in its effect upon performance.

In concluding this brief review of the difficulties encountered in the operation of locomotives under very high steam-pressures, the reader is reminded that an increase of pressure is an embellishment to which each detail in the design of the whole machine must give a proper response. A locomotive which is to operate under such pressure will need to be more carefully designed and more perfectly maintained than a similar locomotive designed for lower pressure, and much of that which is crude and imperfect, but nevertheless serviceable in the operation of locomotives using a lower pressure, must give way to a more perfect practice in the presence of the higher pressure.

The effect of pressure on boiler performance was a point upon which information was desired. The generation of steam at 120 lbs. involves a temperature of the water which is 50 degrees less

than that which must be dealt with in generating steam at a pressure of 240 lbs., and, in general, it has been assumed that any increase in boiler pressure necessarily results in some loss of evaporative efficiency. It has been known that for the small ranges of pressure common in stationary practice, this difference is not great, but the facts have not been established with reference to locomotive performance, or for ranges as great as those covered by the experiments under consideration in any service. The results show that the lowest efficiency is obtained with the highest pressure, and performances under different pressures fall in order inversely with the pressure. The facts thus defined may be stated as follows:

The evaporative efficiency of a locomotive boiler is but slightly affected by changes in pressure.

Changes in steam-pressure between the limits of 120 lbs. and 240 lbs. will produce an effect upon the efficiency of the boiler which will be less than 0.5 pound of water per pound of coal.

Smokebox temperatures increase in all cases as the rate of evaporation is increased. The equations show that the effect of increasing the pressure from 120 lbs. to 220 lbs. is to increase the smokebox temperature 17 degrees; that is, an increase of pressure of nearly 100 per cent. results in an increase of smokebox temperature of approximately 3.5 per cent.

In the preceding statements is to be found an explanation of the constancy in the evaporative efficiency of the boiler under different steam pressures. The fact seems to be that the water in the boiler is about as effective in absorbing the heat of the gases when its temperature is 400 degrees (240 lbs. pressure) as when its temperature is but 350 degrees (120 lbs. pressure).

The data sustain the following conclusions:

1. The smokebox temperature falls between the limits of 590 degrees F. and 850 degrees F., the lower limit agreeing with a rate of evaporation of 4 lbs. per foot of heating-surface per hour and the latter with a rate of evaporation of 14 lbs. per foot of heating surface per hour.

2. The smokebox temperature is so slightly affected by changes in steam-pressure as to make negligible the influence of such changes in pressure for all ordinary ranges.

3. The equation $T = 488.5 + 25.66\ H$, where T is the temperature of the smokebox expressed in degrees F, and H is pounds of water evaporated from and 212 degrees per foot of heating surface per hour, possesses a high degree of accuracy.

Further, pressure has been found to have no effect upon the draft. For example, when the rate of evaporation is 10 lbs. per foot of heating surface per hour, the draft in front of the diaphragm is approximately four inches for all pressures. There is, in fact, no reason why the draft should vary materially with changes in pressure.

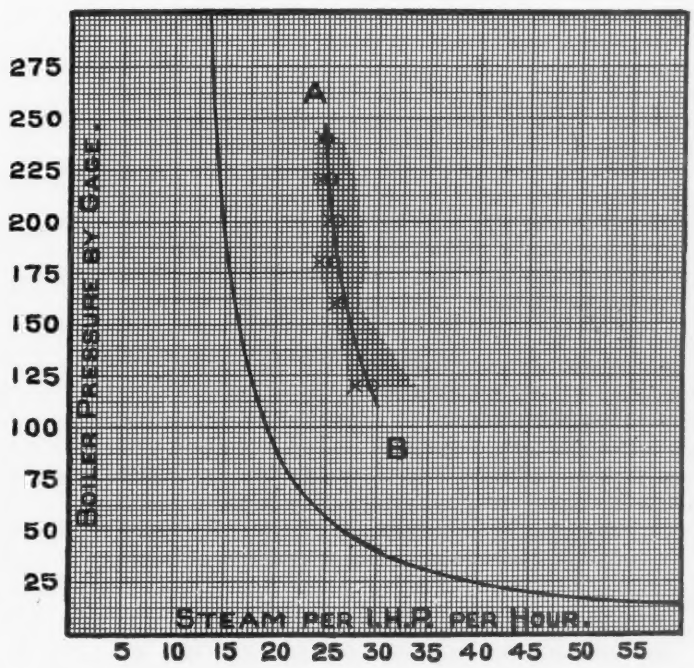
Attempts were made through an analysis of the smokebox gases to explain the variations in the evaporative efficiency of the boiler. The results, however, have not proven entirely satisfactory. That is, where the evaporative performance is abnormal, they do not permit the assignment of a definite cause. They do, however, entirely justify certain general conclusions. They show that the amount of excess air admitted to the furnace is never great, and in most cases it is very small—far below the limits which are thought desirable in stationary practice. They show, also, that the excess air diminishes as the rate of combustion increases. It is apparent, therefore, that the loss in efficiency arising from excess air is under normal conditions smaller than in most other classes of service. Moreover, while the supply of air appears limited, it is significant that the losses from imperfect combustion, as shown by the presence of CO, are also small, the actual amount varying irregularly between limits which are very narrow.

As already indicated in former papers by Prof. Goss, the steam consumption per indicated horse-power is less upon the locomotive than was formerly supposed. For example, it appears that at a pressure of 240 lbs. the engine, when working under a fully open throttle, gave a horse-power hour in return for the consumption of less than 24 lbs. of steam, and under any condition of speed or cut-off for which it was found possible to operate the engine under a wide open throttle the consumption never exceeded 26.3 lbs. At lower pressures involving the possibility of a wider choice in the condition of operating, the range is somewhat increased. Thus, at 120 lbs. pressure the minimum value is 27.5 and the maximum 33.8, a range which, while greater than that just referred to, is nevertheless extremely narrow as compared with the range incident to the operation of other classes of engines.

The most efficient point of cut-off for the lowest pressure is evidently that secured when the reverse lever is in the eighth notch, which is equal to 35 per cent. of the stroke. At 200 lbs. pressure the most efficient cut-off is that represented by the sixth notch, or 27 per cent. of the stroke, and the data do not disclose that a shorter cut-off than this under a full-open throttle is profitable for the engine experimented upon, even though the pressure be raised to 240 lbs.

The effect of speed on steam consumption shows that for all pressures above 160 lbs. the most efficient speed is 40 miles.

For purposes of comparison, the effect of pressure on performance has been defined by a line. In preparing to draw such a line, the average performance of all tests at each of the different pressures was obtained and plotted, the results being shown by the circles on the figure. Points thus obtained can be regarded as fairly representing the performance of the engine under the several pressures only so far as the tests run for each different pressure may be assumed to fairly represent the range of speed and cut-off under which the engine would ordinarily operate. The best results for each different pressure, as obtained by averaging the best results for each speed at constant pressure, are indicated upon the diagram with a light cross. These points may be regarded as furnishing a satisfactory basis of comparison in so far as it may be assumed that when the speed has been determined an engine in service will always operate under conditions of highest efficiency. Again, the left-hand edge of the shaded zone represents a comparison based on maximum performance at whatever speed or cut-off. In addition to the points already described, there is located upon the diagram a curve showing the performance of a perfect engine with which the plotted points derived from the data of tests may be compared. This curve represents the performance of an engine working on Carnot's cycle, the initial temperature being that of the several pressures stated, and the final temperature being that of steam at 1.3 lbs. above atmospheric pressure. This latter value is the assumed pressure of exhaust in locomotive service.



Guided by this curve, representing the performance of a perfect engine, a line A B has been drawn proportional thereto, and so placed as to fairly represent the circular points derived from the experiments. It is proposed to accept this line as representing the steam consumption of the experimental engine under the several pressures employed. It is to be noted that it is not the minimum performance nor the maximum, but it is a close approach to that performance which is suggested by an average of all results derived from all tests which were run. Since its form is based upon a curve of perfect performance it has a logical basis, and since it does no violence to the experimental data its use seem justifiable.

An examination of all of the data obtained that are comparable shows that the values, especially if confined to the tests run with the reverse lever in the second, fourth and sixth notches, show but slight variation in the coal consumed per horse-power hour either with changes of speed or with changes in pressure. The fact, also, that the record shows but three out of 46 tests, representing a great variety of running conditions, for which the consumption exceeds

4 lbs., argues well for the efficiency of the locomotive in ordinary service.

The record of coal consumption shows that this performance is affected by variations in the evaporative efficiency of the boiler, due doubtless to irregularities of firing, but which are in fact unaccounted for.

An analysis of the general results obtained is summarized in a statement which may be accepted as a general definition of performance, assuming all irregularities to have been eliminated. Such a summarized statement may be expressed by the equation:

$$E = 11.305 - 0.221\ H$$

in which E is the number of pounds of water evaporated from and at 212 degrees per pound of coal, and H is the number of pounds of water evaporated from and at 212 degrees per foot of heating surface per hour.

It appears, also, from the data that the steam consumed by the cylinders varies for each different pressure with changes in speed and cut-off, and it has been sought to summarize the facts derived from the experiments into a single expression. This appears in the form of the curve A B, which is to be accepted as representing the performance of the cylinders under different pressures without reference to speed or cut-off. Combining this general statement expressing cylinder performance with that already obtained covering boiler performance, it should be possible to secure an accurate measure of the coal consumption per indicated horse-power hour, for each different pressure which will represent the results of all tests at that pressure.

The steps in this process are set forth by the table.

Engine Performance Under Different Pressures.

Boiler pressure.	Steam per i. h.-p. hour, Values frm curves.	B. t. u. given to 1 lb. steam feed-water*	Equivalent lbs. of water: Per i. h.-p. hr.	Equivalent lbs. of water: Per lb. of dry coal.	Lbs. coal per ind. h.-p. hr.	Coal saving, each increment, Pounds.	Coal saving, each increment, Pr cent.
1.	2.	3.	4.	5.	6.	7.	8.
240 lbs.	24.7	1,176.6	30.09	9.10	3.31	0.06	1.8
220 "	25.1	1,174.4	30.52	9.06	3.37	.06	1.8
200 "	25.5	1,172.0	30.94	9.03	3.43	.07	2.0
180 "	26.0	1,169.5	31.48	8.99	3.50	.09	2.5
160 "	26.6	1,166.8	32.14	8.94	3.59	.18	4.8
140 "	27.7	1,163.8	33.38	8.85	3.77	.23	5.8
120 "	29.1	1,160.5	34.97	8.73	4.00	...	...

*Temperature at 60 deg. F.

The values, especially those of columns 2 and 6, are of more than ordinary significance. They represent logical conclusions based upon the results of all tests. Comparisons between them will show the extent to which the performance of a locomotive will be modified by changes in the steam-pressure under which it is operated. They show in the matter of steam consumption (column 2) that—

Increasing pressure from 160 to 180 lbs. reduces the steam consumption 0.6 lb., or 2.3 per cent.

Increasing pressure from 180 to 200 lbs. reduces the steam consumption 0.5 lb., or 1.9 per cent.

Increasing pressure from 200 to 220 lbs. reduces the steam consumption 0.4 lb., or 1.6 per cent.

Increasing pressure from 220 to 240 lbs. reduces the steam consumption 0.4 lb., or 1.6 per cent.

In the matter of coal consumption (column 6) they show that—

Increasing pressure from 160 to 180 lbs., reduces the coal consumption 0.9 lb., or 2.5 per cent.

Increasing pressure from 180 to 200 lbs. reduces the coal consumption 0.7 lb., or 2.0 per cent.

Increasing pressure from 200 to 220 lbs. reduces the coal consumption 0.6 lb., or 1.8 per cent.

Increasing pressure from 220 to 240 lbs. reduces the coal consumption 0.6 lb., or 1.8 per cent.

These values are from actual tests. Those who are inclined to insist upon basing their conclusions upon observed data will perhaps find in them a satisfactory conclusion of the whole investigation. The results show how slight is the gain to be derived from any increment of pressure when the basis of the increment is above 160 lbs. But they do not in fact tell the whole story. In order to secure such results from a single locomotive it was necessary to employ a machine designed for the highest pressure experimented upon. Obviously, for the tests at lower pressure, the locomotive was needlessly heavy for its dimensions. If for the tests under each of the lower pressures the excess weight could have been utilized in providing a boiler of greater heating-surface, the difference in performance with each increment of pressure would have been less than that to which attention has already been called. It is for this reason that the results already quoted, while significant and concise in their meaning, are nevertheless to be accepted as insufficient when regarded as a relative measure of the value of different steam-pressures.

The final test of locomotive efficiency from the standpoint of the operating company is the amount of coal used per dynameter horse-power or, as it is more familiarly expressed, per ton-mile hauled. The factor represents the combined performance of the boiler, the cylinders and the machinery of the locomotive. It connects the energy developed in the boiler by the combustion of fuel with that developed at the drawbar. From the data obtained it appears that the coal consumption per horse-power hour at 240 lbs. ranges from 3.35 to 5.01 lbs., while at a pressure of 160 lbs. the range is between 3.79 and 4.78 lbs., conclusions which are of interest from at least two points of view. First, because of the small difference in performances resulting from a relatively large change in pressure, and, second, because of the significance of the values quoted when accepted as a measure of locomotive performance. It is doubtful if any other type of steam engine exhausting into the atmosphere can be depended upon to deliver power from the periphery of its wheel in return for the expenditure of so small an amount of fuel.

From the discussion of the effect of increasing pressures compared with increasing boiler capacity it appears that there is a decided economical advantage in increasing the pressure when the basic pressure is low, but as this latter is raised, this advantage disappears until they are about balanced at 160 lbs., whereas there is no possible excuse for increasing the pressure beyond 320 lbs.

NEW PUBLICATIONS.

Boiler Waters. By William Wallace Christie. New York: D. Van Nostrand Co. 235 pages; 6 in. by 9 in.; 77 illustrations; cloth. Price, $3.00.

This book will be found to be a convenient reference for matters regarding the formation of scale, the corrosion of boiler plates and the foaming of the water. It is a compilation or collection of data on the subject that cover the principal impurities to be found in the usual run of feed waters, their effects upon the boiler and the means to be used to counteract such effects as may be injurious. The work opens with a statement of the impurities that are to be found, and then follows an outline of the methods to be followed in analyzing for them. In this no attempt is made to give instruction in chemistry, but there is a detail of the simple apparatus to be used and the methods to be followed to get quick results. The instructions are clear and concise and are such that a man of ordinary intelligence should, when prospecting for water, be able to ascertain whether that which is offered is fit for boiler purposes or not.

In treating of boiler scale, in the second chapter, there are a number of "awful examples" given of accumulations that have been removed from neglected boilers, and these are followed by a few rules that should be followed for the prevention and removal of such accumulations, with a statement of the effect of various scales on heat conduction and the evaporative efficiency of a boiler. The same method of example, cause and remedy is followed in the treatment of corrosion and foaming. The effects of oil and galvanic action are dealt with for the most part by extracts from other reports in which the results of investigations are summarized. A separate chapter is devoted to hardness, the means used in its determination and removal. There is also a chapter descriptive of the various feed-water heaters that are upon the market, and a closing one in the text on water softening or purification. There can be no summing up of conclusions, but the book opens the field for each individual to make inquiries along the lines of his own requirements guided by the experience of others. The last chapter contains a series of tables of the usual character on the conversion of metric to English measurements, on the properties of water and saturated steam, with a list of the chemical symbols of the substances entering into the subject. The book thus forms, as already stated, a valuable collection of data upon the important topic with which it deals and can be used as a guide by those who are having trouble with the waters used in their boilers.

CONTRIBUTIONS

Track Tanks.

Jersey City, N. J., March 16, 1908.

To the Editor of the Railroad Gazette:

I have read with interest the article on Track Tanks by Mr. Ross in your issue of March 13, and would like to add the results of some trials made on the Pennsylvania Railroad at Atglen, Pa., in October, 1906, under the direction of Frank Goodfellow.

The tanks at Atglen are on a curve and so are not directly

comparable to those on tangent. During the trials, runs were made over a standard 19-in. trough and large ones, 29 in., both with and without lips, as shown in Figs. 1, 2 and 3. Trials were also made with a closed and semi-closed deflector and with a modified dipper, i.e., modified from the standard Pennsylvania Railroad dipper, as described in the *American Engineer and Railroad Journal*, November, 1896, and the *Railroad Gazette*, January 8, 1897. The

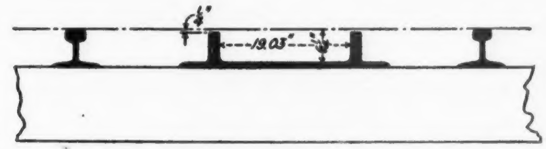


Fig. 1—Standard 19 in. Trough.

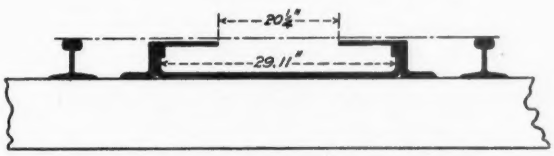


Fig. 2—Trough, 29 in., without Lips.

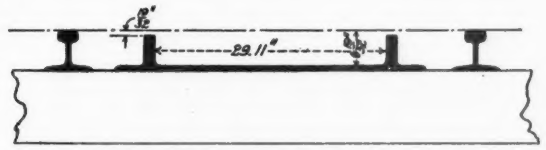


Fig. 3—Trough, 29 in., with Lips.

trials showed poor results or such slight increases in efficiency as to be more than counterbalanced by the increased complication.

Fifteen runs were made over each type of trough with the standard scoop; of these, three were made at each of the following speeds, 20, 30, 40, 50 and 60 m.p.h., and the results averaged, thus getting a fairly accurate figure. The results of the trials of the two 29-in. troughs show that the trough without lips is the more efficient from 32 to 48 m.p.h., while at all other speeds the trough with lips is better. In comparing the 19-in. trough with the results of the 29-in. one with lips, the latter is the better up to 30 m.p.h., while at all higher speeds the 19-in. one gives better results, as will be seen from the efficiency curve, Fig. 4.

From this it would seem to be good practice to install a 29-in. trough with lips on freight tracks, where the average running speed would be less than 30 m.p.h. This would be so from a motive power standpoint considering only the amount of water delivered to tender, but taking maintenance into account this would not do as a larger quantity of water is thrown on the right-of-way, thus offsetting any gain due to larger tank fulls.

The speed for greatest economy was found to be 40 m.p.h., which makes the minimum splash with a correspondingly large

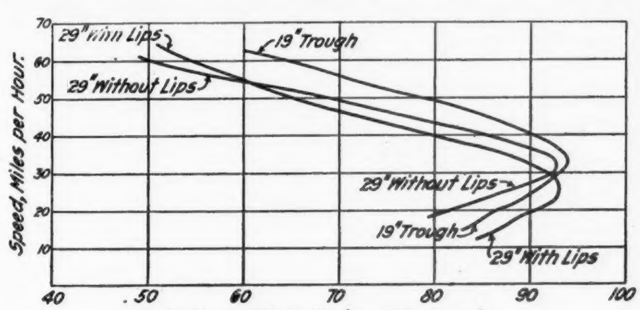
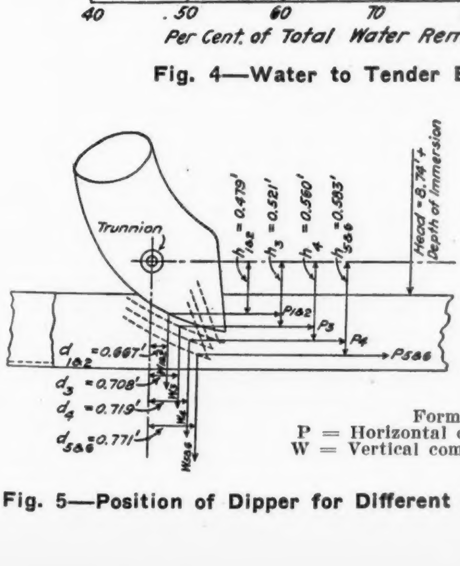


Fig. 4—Water to Tender Efficiency.



Formula: Wd = Ph.
P = Horizontal component or drawbar pull.
W = Vertical component or load on dipper.

Fig. 5—Position of Dipper for Different Depths of Immersion.

amount to tender per foot of length of trough. A comparison of the results at this speed is shown in table 1.

TABLE 1.

		With lips,	No lips,
Trough	19 in.	29 in.	29 in.
Speed, miles per hour	40 miles.	40 miles.	40 miles.
Total water removed per lin. ft. of trough	.2892	.3355	.3156
" " to tender per lin ft. of trough	.2655	.2955	.2728
" " spilled per lin. ft. of trough	.0137	.0400	.0428
Per cent. water to tender	96.50	85.25	87.00
Per cent. water spilled	3.50	14.75	13.00

It might be of interest in passing to mention the action of the water in the trough when the dipper is lowered. To make observations of this, the special tender used was fitted with open flooring and a cage hung between the trucks from which an observer could get a good view of the action and, in most of the runs, photographs. At 30 and 40 m.p.h., the writer passed back from around the point of the dipper in a thin sheet about the width of trough, and fell about 5 ft. back of the tender, striking the disturbed water in the trough and splashing out at the sides. This action is not restricted to the trial tender but may be observed on fast passenger trains, the water flying back, at times, far enough to be thrown down by the forward trucks under the first car of the train. At 50 and 60 m.p.h. there was so much splash that the rear truck of tender was hidden from view, while looking down from the top the whole point of the dipper could be seen cutting the water with no appreciable frothing. As the speed diminishes, a wave action is set up in front of the dipper, the water being piled up until it falls over the sides. This wave increases in size up to the point where the velocity imparted to it is less than that necessary to overcome the resistance due to gravity and friction, when, of course, no more water is lifted.

A summary of the results shows conclusively that with the standard type of dipper the 19-in. trough is the more economical when all speeds are taken into consideration.

Some interesting calculations of the load on scoop and the resultant force on the drawbar for different depths of immersion were made from the results of the Bellwood trials in August, 1906.

Fig. 5 shows the positions of the dipper at different depths of immersion, the vertical distances are taken from the point of support or trunnion to the point of impact of the dipper and water, or the point where the water changes its direction and the horizontal distances are from point of impact to center line of trunnion.

From this, the results shown on Table 2 have been calculated from the moment about the trunnion. In the upper portion of the table will be found the calculations based on the weight of water delivered to tender, while the lower portion is based on total water removed from trough.

TABLE 2.

	Calculated							
	From water to tender				From total water removed			
		Component P force at drawbar		Comp. W, load on dipper,		Component P force at drawbar		Comp. W, load on dipper
Test.	Speed, in m. p. h.	Pounds.	D. h.p.	lbs.	Speed in m. p. h.	Pounds.	D. h.p.	lbs.
1....	25.7	557.6	38.21	400.4	25.7	571.9	39.19	410.7
2....	29.3	700.3	54.71	502.9	29.3	791.0	61.80	568.0
3....	30.8	904.2	74.26	655.2	30.8	960.3	78.86	695.8
4....	39.9	1,430.2	152.19	1,010.2	39.9	1,487.9	158.14	1,050.7
5....	51.9	2,374.0	328.52	1,795.1	51.9	2,764.6	382.60	2,090.5
6....	58.3	2,935.5	456.32	2,219.5	58.3	3,494.9	543.22	2,642.5

From this it will be seen that at high speeds, 50 to 60 m.p.h., the load on the scoop is about a ton, while the corresponding calculated dynometer horse-power reaches from 450 to 550, or about one-half of the available horse-power of an Atlantic locomotive at that speed.

It is therefore good policy for enginemen of high-speed trains to slow before taking water and for those of low-speed trains to increase it, if possible, to get the greatest economy.

B. S. MURPHY,
Mechanical Inspector, Hudson Companies.

What Are We Going to Do About Accidents?

March 28, 1908.

TO THE EDITOR OF THE RAILROAD GAZETTE:

With reference to the letter of "General Manager," which appeared in your issue of Feb. 28, there can be no doubt whatever that the frequency of train accidents is viewed by operating officers with great anxiety, and the necessity of raising the average of efficiency and intelligence in the ranks of employees, by the weeding out of careless and incompetent men, must be universally recognized. "General Manager" attaches considerable importance to surprise checking as a means of exposing carelessness and incompetency, but it should not be overlooked that there must be a moral force acting in support of any such system, which if properly sustained by the executive, over which "General Manager" presides, will induce among the rank and file a sense of personal pride in a service and create a standard of private honor rising very much higher than the principle expressed by surprise checking.

"General Manager" says that "it is unquestionably practicable to lessen the number of train accidents." I quite agree, and I think that the lines along which this is likely to be accomplished is in

the direction of raising the moral standard of the men. Much can be done by the influence of example. Rules and precepts discouraging and prohibiting drinking among railroad men hopelessly fail in their effect if they are not supported by good example. The highest officers are concerned in this as well as superintendents and heads of departments, and if they do not realize that some sacrifice in the interest of discipline is necessary on their part, they cannot reasonably expect—taking human nature as it is—compliance with stringent instructions which the men know are based upon precept only and not on practice. I venture to think, for instance, that if the use of intoxicating liquor was abolished from official cars, it would, by the influence of example materially strengthen the efforts of departmental officers in removing the standing menace of drinking, which though happily reduced in every direction, still exists to a dangerous extent.

In every regulation dealing with personal conduct and attitude while an employee is on duty, or in and about the premises of a railroad company, the officers should take a distinct lead and set up the standard which they wish their men to follow on every possible opportunity.

"General Manager" suggests that the record of 100 per cent. of the men who were found obedient to the rules when surprised is false, and this circumstance just serves to illustrate my point. The weakness or strength of the moral fiber amongst men in a large organization will, generally speaking, be a reflex of the principles of general and departmental control. In "General Manager's" case, there is an obvious want of confidence in both departmental officers and men, and I suggest that with this spirit pervading his organization, too much should not be expected as the result of what is merely a mechanical check. Officers, and particularly superintendents, should have greater faith in their men and should more fully appreciate their own responsibility in cultivating a higher morality which is the real basis of efficiency and honest service, and which should make the suspicion which haunts "General Manager's" mind impossible.

Is he satisfied, that in exercising his authority in matters concerning the staff as a whole, he has given adequate consideration to this aspect of his administrative work? If a company stands square before the men who compose its working force, and the principles of control are transparently honest as they should be, there should be no room for suspicion and distrust. Nothing can be so prejudicial to the spirit of individual loyalty as an influence of this kind. Loyalty to a service shows itself in the spontaneous display of interest and energy on the part of employees, and this is the actual source of the general efficiency at which we are all aiming and which can only be successfully developed along the lines of mutuality between the management, departmental officers and the staff. If "General Manager" should quietly check up his departments in this direction, it is not unlikely that the feeling of distrust to which he has given expression would be found to have its source in a lack of co-operation or a laxity of principle for which his own policy may even be directly responsible.

I firmly believe that the great majority of railroad men are not only willing but anxious to strictly comply with the rules of safe operation, and as a general suggestion I would say that the district officers should meet the men more frequently than is the case at present. The nature, cause and prevention of every accident that occurs should be thoroughly explained either by means of printed descriptions or in conference. A man may fail at a critical moment, not as the result of neglect, but because he may be in doubt on some point which has not been made clear to him. The responsibility in such a case extends, I think, to the management. The officers find it necessary to confer frequently, and at a reasonable cost, it would be a sensible and profitable investment to provide facilities whereby the men could meet and discuss problems of everyday railroading assisted by some of the officers. By these means uniformity of practice could be secured and any conflict of opinion as to the interpretation of certain rules would be removed. A healthy individual interest would be excited and a way would be cleared for the subsequent adoption of a system of oral examinations, than which no better means of testing intelligence and efficiency could be devised.

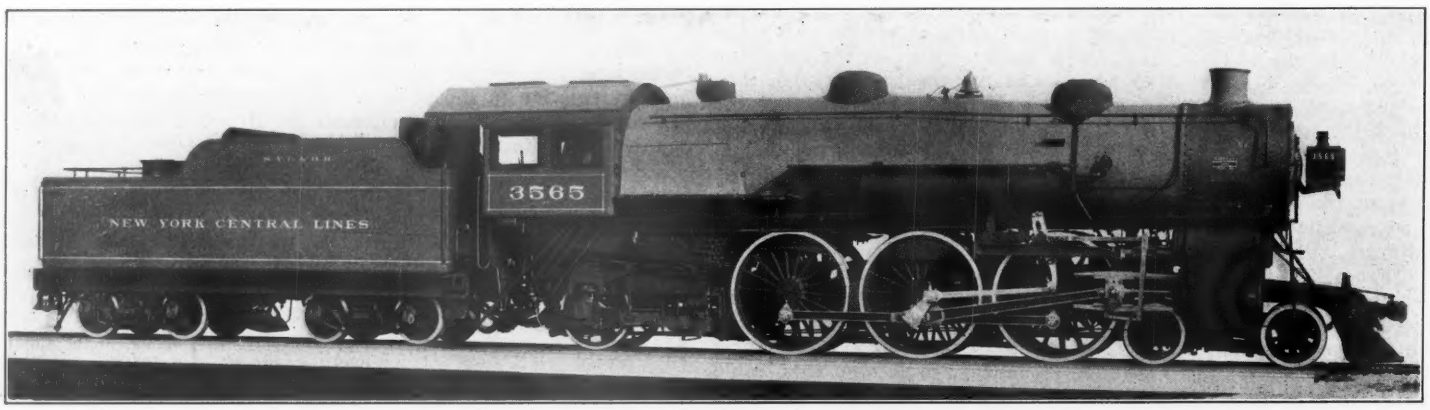
SUPERINTENDENT.

Pacific Locomotive for the New York Central.

The Schenectady works of the American Locomotive Co. have recently completed an order of 40 Pacific type locomotives for the New York Central & Hudson River Railroad. These are the heaviest passenger locomotives ever built for this road and will be used in hauling through trains. At the present time these trains are handled by a 21½ x 26 Atlantic type engine, having a maximum tractive power of 23,300 lbs. The reason for adopting the Pacific type in ordering new passenger equipment was that the Atlantic type engine did not provide the necessary adhesive weight for starting purposes to satisfactorily meet the requirements.

In general, the engines here illustrated are duplicate in design of a previous lot built last year by the same builders for the Lake Shore & Michigan Southern, which took the place of the Prairie type as the standard high-speed passenger engine on that road, and are now hauling all their important trains, including the Twentieth Century Limited. It is probable that this new class will become the standard type of heavy passenger power for all the New York Central Lines.

In working order these engines have a total weight of 266,000 lbs., of which 171,500 lbs. is carried on the driving wheels. The cylinders are 22 in. diameter by 28 in. stroke, and with driving wheels 79 in. in diameter and a working pressure of 200 lbs., the engines will develop a maximum tractive effort of 29,200 lbs.

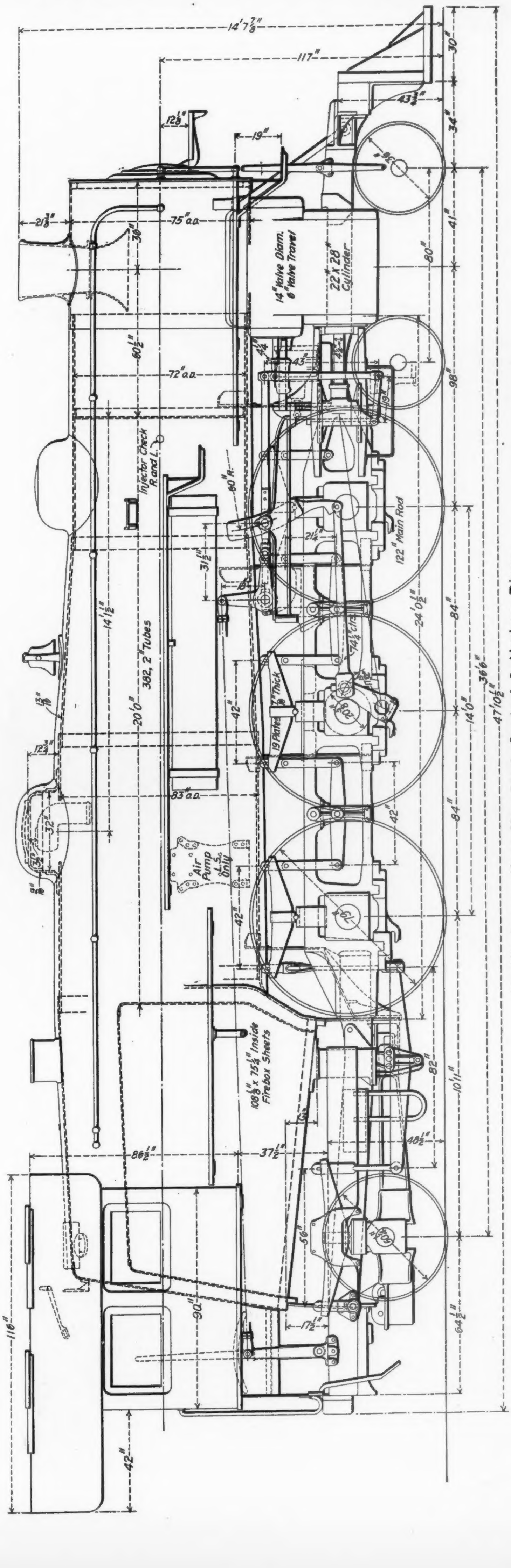


Pacific Locomotive; New York Central & Hudson River.

Especial attention was paid in working out the design to providing a boiler of the highest capacity, and it will be seen from an examination of the principal ratios given below that in this respect the design is considerably above the average Pacific type engine. The boiler is of the radial stayed type with a conical shaped middle ring and the outside diameter of the front ring is 72 in. It contains 382 tubes 2 in. in diameter and 20 ft. long, and provides a total heating surface of 4,210 sq. ft., of which the tubes contribute 3,982 sq. ft. and the firebox and arch tubes the remainder. The firebox is 108⅛ in. long and 75¼ in. wide and has a grate area of 56.5 sq. ft.

In accordance with the present requirements in locomotive design the boiler is raised high above the frames, the top of the front course being 12 ft. 10½ in. above the rails. This cuts down the space available for the dome, which is only 12¾ in. above the shell and also drops the throttle down so that its lower opening is about flush with the top of the shell. It will leave about 15 in. between the surface of the water, when it stands at the second gage, and the throttle, and this may be cut down as low as 11 in. with more water and the engine on a grade; while, with the surging of the water, when the engine is in motion the wave crest may come very close to the throttle itself. Attention is called to these points merely to show how allowances that were formerly considered the minimum have been cut down until they have practically disappeared under the stress of the later designs. Compare this clearance with that obtained with the old boilers with a high dome on the wagon top and the difference will be seen to be very marked. In the same way there is a tendency on recent designs to place the injector check well up to the front tubesheet. In this case there is but 8½ in. from the center to that sheet, and this in spite of the protests that have been made that such close proximity tends to leaky tubes. Evidently that claim is not being substantiated.

Part of the engines built on this order have been fitted with



Pacific Locomotive; New York Central & Hudson River.

steel tubes and the balance with charcoal iron. At the firebox end the slope of the side-sheets is such that there is a chance for a free liberation of the steam over the entire surface with a direct rise away from the metal throughout the whole distance from the foundation ring to the crownsheet. The spread of the sheets is 75¼ in. at the bottom, drawing in to 62 in. at the springing point of the curve of the crownsheet. This gives an inward slope of 1 in 7 to the sheet. Again it may be well to contrast the conditions for steam liberation thus obtained with those of the narrow firebox set between the frames, where the waist of the firebox was drawn in as with corsets, and the steam trailed over the side sheets the whole distance from the point of its generation to the space provided for it over the crownsheet. With the wide firebox, the quality of the steam as it enters the steam space must be much dryer than was possible with the old firebox, and thus the necessity for the great height to the throttle no longer exists. Besides this, the film of steam over the sidesheets should be much thinner than before, resulting in cooler sheets and a reduction of the stresses on the staybolts.

In general design the engine embodies no especial novelties and the interest in it lies, for the most part, in its size, the smoothness of its lines and the pleasing symmetry of its proportions. Cast-steel is used for the parts usually made of that material, and the engine is equipped with the ordinary fittings in the way of high-speed brakes, etc. In some of the ratios it will be noticed, as we have said, that the results are somewhat higher than usual. Thus, the ratio of tractive effort to weight is 5.84, which is well above common practice.

The following are some of the principal dimensions of these engines:

Cylinder, diameter	22 in.
Piston, stroke	28 in.
Wheel base, driving wheel.	14 ft.
" total	36 ft. 6 in.
" total, engine and tender	67 " 11 "
Weight on drivers	171,500 lbs.
" total	266,000 "
" engine and tender	430,000 "
Heating surface, tubes	3,981.6 sq. ft.
" " firebox	199.9 "
" " arch tubes	28.4 "
" " total	4,209.9 "
Grate area	56.5 "
Journals, driving axle	10½ in x 12 "
" engine truck	6½ " x 12 "
" trailing truck	8 " x 14 "
" tender (M. C. B. standard)	5½ " x 10 "
Boiler, diameter, first course	72 in.
Steam pressure	200 lbs.
Firebox, length	108⅛ in.
" width	75¼ "
" thickness, crown, side and back sheets	⅜-in.
" thickness tube sheet	½-in.
" water space	4½ in.
Tubes, number	382
" diameter	2 in.
" length	20 ft.
Exhaust nozzles, diameter	5½ in. and 5¾ in.
Tank capacity water	8,000 gals.
Tank capacity, coal	14 tons.
Valves, travel	6 in.
" lap	1 "
" clearance	⅛-in.
" lead	¼-in.
Wheels, diameter, driving	79 in.
" " front truck	36 "
" " trailing truck	50¼ "
" " tender	36 "
Tractive effort	29,200 lbs.

$$\frac{\text{Weight on drivers}}{\text{Tractive effort}} = 5.84$$

$$\frac{\text{Total weight}}{\text{Tractive effort}} = 9.11$$

$$\frac{\text{Tractive effort x diameter of drivers}}{\text{Heating surface}} = 550.0$$

$$\frac{\text{Heating surface}}{\text{Grate area}} = 74.5$$

$$\frac{\text{Firebox heating surface}}{\text{Total heating surface}} = 4.74^{*}$$

$$\frac{\text{Weight on drivers}}{\text{Total heating surface}} = 40.7$$

$$\frac{\text{Total weight}}{\text{Total heating surface}} = 63.1$$

Volume of both cylinders, cu. ft. = 12.32

$$\frac{\text{Total heating surface}}{\text{Volume of both cylinders}} = 341.0$$

$$\frac{\text{Grate area}}{\text{Volume of both cylinders}} = 4.58$$

*Per cent.

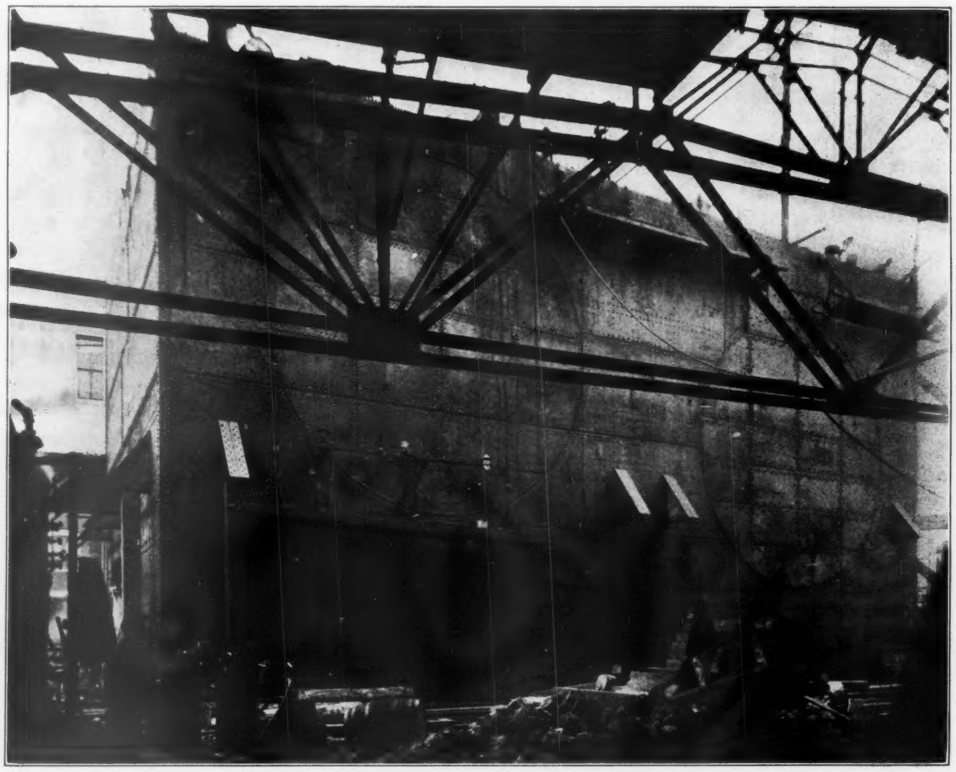
The East River Tunnels of the Pennsylvania Railroad.

The four tunnels of the Pennsylvania Railroad under the East river, connecting Manhattan Island at Thirty-third street with Long Island City, have now all been bored through, so that it is possible to walk under the river in any one of the four tubes. It was long the hope of the late Austin Corbin, President of the Long Island Railroad, to have rail connection between Long Island and Manhattan, but it was left to the great foresight and genius for railroad construction, operation and financing of the late A. J. Cassatt, President of the Pennsylvania Railroad, to carry through such a plan. The Long Island Railroad was bought by the Pennsylvania on the strength of the potentialities of its territory. Mr. Cassatt saw that Long Island, now scarcely profitable to a railroad, held great possibilities for development of traffic when directly connected with Manhattan Island. The tunnel extension to Long Island is part of the comprehensive scheme evolved by him and his right-hand helper in working out these great plans for the New York terminal improvements, Samuel Rea.

The East river tunnels of the Pennsylvania and the great air power plants which furnish the air pressure used in their construction were described in great detail in the *Railroad Gazette* of July 6 and July 27, 1906. The present article is in the nature of a brief general summary of the work, marking the successful completion of all four of the tunnel tubes. The photographs show excavation in rock, the face of one of the shields in rock, the erector at work putting steel plates in the tunnel lining, one of the great caissons, and the floating equipment used in the work.

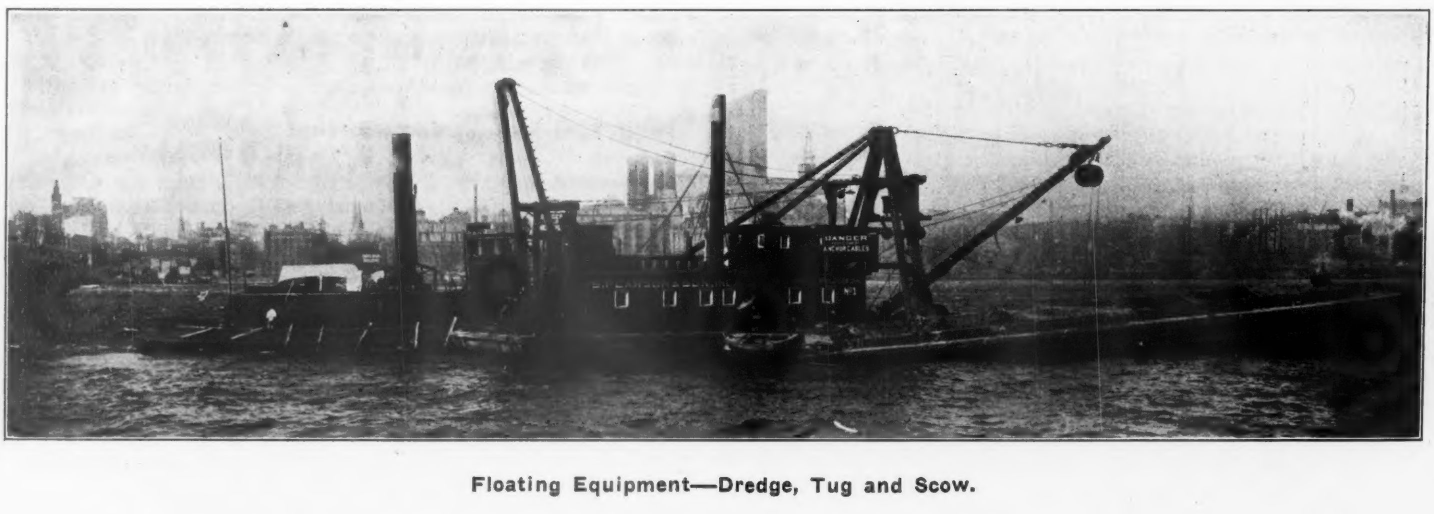
The Pennsylvania East river tunnels begin in two steel caissons sunk between First avenue and the river front, Manhattan, and continue in a pair of tunnels driven from each caisson under the Manhattan ferry slips of the Long Island Railroad and the East river to a similar pair of caissons sunk on the water front at Long Island City, just south of the Long Island Railroad ferry slips on that side of the river. Thence they continue diagonally underneath the Long Island Railroad tracks, gradually converging and passing under Vernon avenue and meeting in one shaft at East avenue, Long Island City. The total length underneath the river, from caisson to caisson, is about 4,000 ft., and from the Long Island City caisson to East avenue, 2,000 ft. The work was divided into three working sites, 2,000 ft. of four tunnels being driven from each site. The divisions were as follows: 2,000 ft. from the Manhattan shafts to the center of the river, 2,000 ft. from the center of the river to the Long Island City shafts, and 2,000 ft. from the Long Island City shafts to the East avenue shafts. The total length of the four tunnels is 24,000 ft. The outside diameter of each tunnel is 23 ft. The tunnels are lined throughout with cast iron tunnel lining in rings 2 ft. 6 in. long, divided into 11 segments and a key, each ring weighing 11½ tons and each segment except the key weighing about one ton. There were about 100,000 tons of cast iron lining used, and 1,500,000 bolts of 1½ in. diameter used in fastening the segments together. The tunnels are to be lined with concrete 2 ft. thick. The vitrified conduits for carrying electric light and power cables, of which there are 1,000,000 ft., are built in benches on each side of the track. These benches form a sidewalk for passengers in case trains are stalled in the tunnel.

The construction problem presented at the time the plans for these tunnels were made was a new one. Their cost was problematical, and the estimates of the engineers, estimates and nothing more. One bidder on the contract proposed to build the tunnels by the freezing method; another made it clear by his proposal that he had no knowledge of the real nature of the work. The accepted bid was that of S. Pearson & Son, Ltd., of London, who had not only recently successfully driven the Blackwall tunnel, with an outside diameter of 27 ft., under the Thames river in England, at that time the most difficult work of this sort ever carried out, but had been the contractors in 1889-1890 for the tunnel under the Hudson river from Hoboken to Morton street, New York, the first sub-aqueous tunnel ever driven by the shield method.



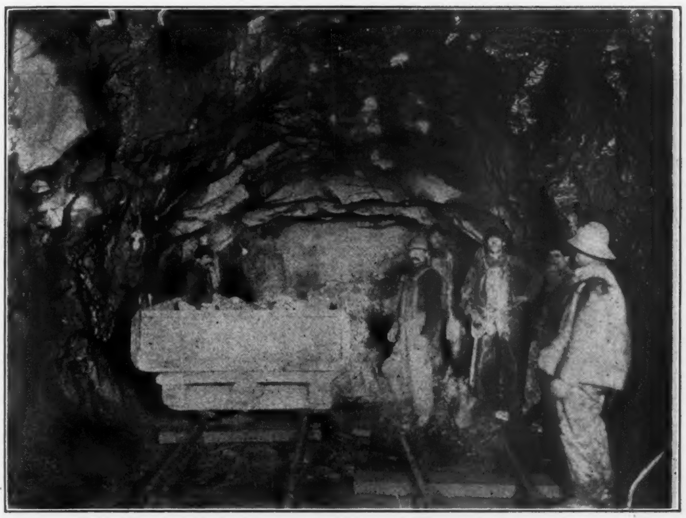
One of the Caissons at Long Island City.

This tunnel, which was on February 25, 1908, opened to travel by the Hudson & Manhattan Railroad, had before 1889, been pushed 2,000 ft. out from the New Jersey shore of the Hudson river, where the heading had been abandoned and the tunnel had caved in. In order to regain the heading of this old tunnel, a great canvas balloon filled with hay and clay was dropped from a floating derrick into the cavity. This kept the water out long enough so that it was possible to regain the tunnel, excavate the silt and build a chamber in which, under an air pressure of 42 lbs. to the square inch, the shield was erected. This, because shield tunneling was then a new art, was probably the greatest and most daring feat in the history of subaqueous tunnel work. This shield was advanced and cast iron lining built behind it for between 2,000 and 3,000 ft., and it was being advanced at the rate of 10 ft.



Floating Equipment—Dredge, Tug and Scow.

a day when the company which was carrying on the enterprise failed and the contract was abandoned, to be taken up again in recent years by the Hudson & Manhattan Railroad. The old shield left in the tunnel in 1890 was used to finish the work in 1907. The boring in 1890 was done by E. W. Moir, now Vice-President and

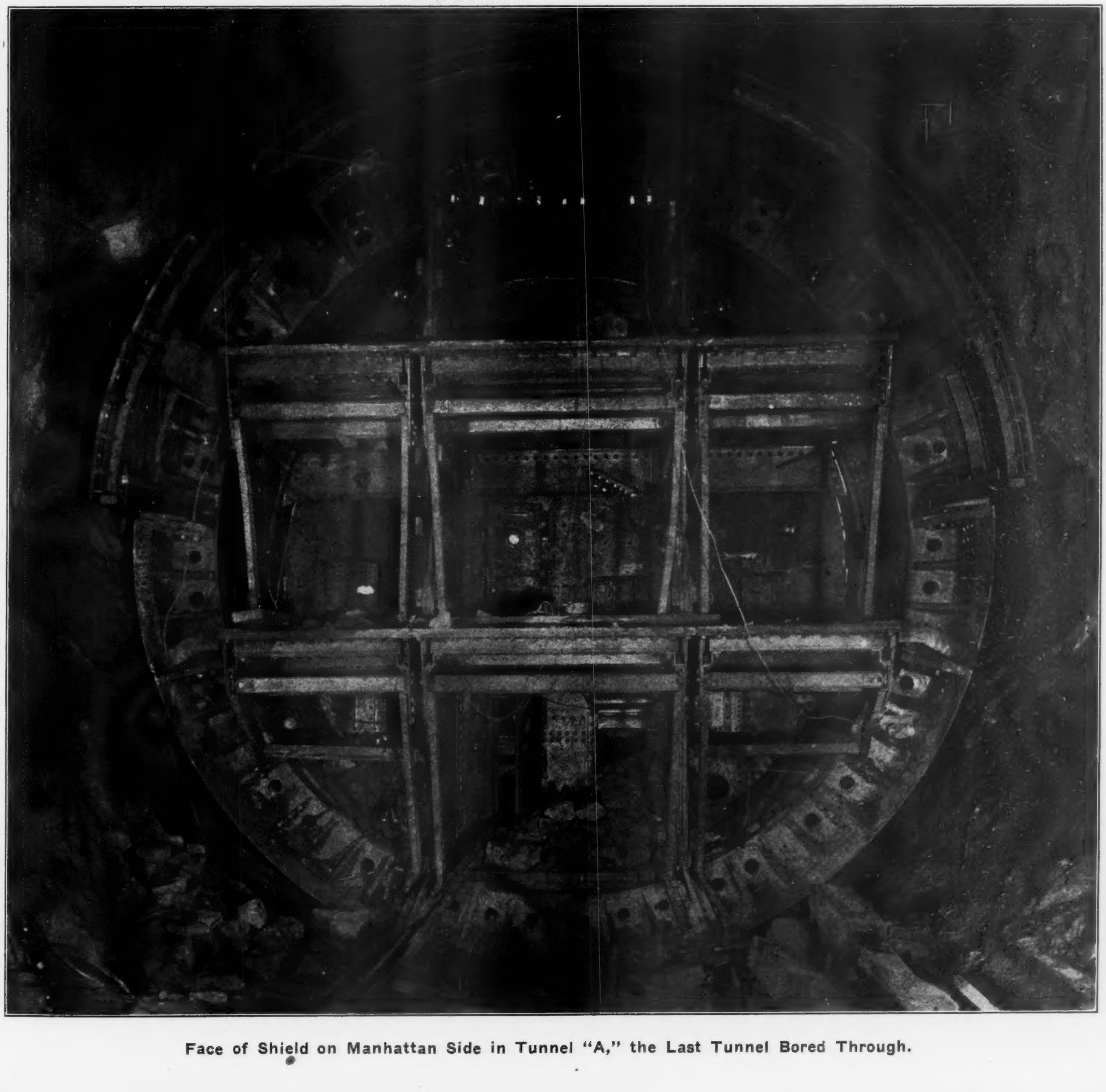


Excavating in Rock.

Chief Engineer of S. Pearson & Son, Incorporated, which is the name of that branch of the firm which is carrying out the East river tunnel contract. The fact that the wide experience of Mr. Moir and of his firm in subaqueous tunneling was available, as well as the fact that the reputation of S. Pearson & Son, Ltd., as successful contractors—successful both for themselves and for their employers—was generally recognized throughout the world, made this firm the most desirable bidder on this difficult contract.

In March, 1904, when the contract for the East river tunnels was let, there was only one small tunnel tube under the East river. This was known as the East river gas tunnel and ran under Blackwell's Island, being sunk so deep that it was almost entirely in solid rock, though some seams of soft, decomposed rock were met with, which necessitated the use of very high air pressure. The two Battery tubes of the Interborough Rapid Transit subway to Brooklyn had been well started on the Manhattan side, but as the formation there was entirely rock these had given no experience of the formations to be expected under the main part of the East river. Subsequently the Belmont (Steinway) tunnel was pushed through, advantage being taken by William Barclay Parsons in its construction of the Man o' War's reef, a continuation of the Blackwell's Island reef, on which a shaft was sunk. From this shaft, tunnels were driven in each direction to meet the shields coming from Manhattan and from Long Island, thus virtually cutting in half the time necessary for completion. There was no such favorable formation of which the Pennsylvania tunnels could take advantage.

The trial borings in the bed of the East river showed that the strata on the lines of the tunnels were rock on each side of



Face of Shield on Manhattan Side in Tunnel "A," the Last Tunnel Bored Through.

the river, sloping down so that the tunnels would emerge into a full face of boulders and quicksand beyond which would be reached silt and quicksand without boulders. The Man o' War's reef in the middle of the river stands up against the quicksand in such a way that the roof of the tunnels comes sometimes 10 ft. above the reef and sometimes only 1 ft. above, but it is seldom that there is sufficient rock in the roof to form a safe cover for the workmen. The problem, therefore, was to tunnel by a shield through a mixture of quicksand and rock and through quicksand alone.

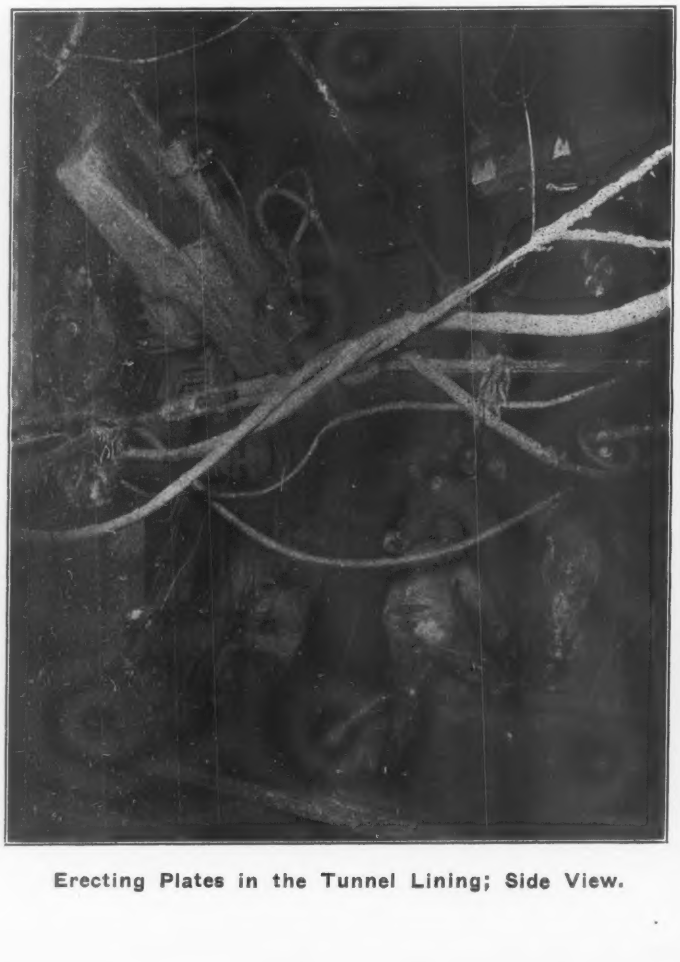
In trying to keep the air pressure high enough to overcome the head of water and quicksand at the bottom of the tunnel, there was a constant risk of blowing off the roof of quicksand and allowing the water to pour in from above. If the pressure was lowered sufficiently to prevent blowouts, the quicksand flowed from under the shield and between the joints of the tunnel lining and allowed the tunnel to settle, and after the pressure was raised high enough to prevent this the roof was blown off and the tunnels flooded.

Mr. Moir foresaw and guarded against this danger by specifying that permission should be gained from the War Department for dumping clay in the river bed to a sufficient depth to allow the air pressure to be raised without causing blowouts. The necessity of this can be realized from the fact that at certain points the tunnels have only 7 ft. of quicksand between them and the water of the river. After the full permit was obtained for dumping the clay, no flood of water occurred in any of the eight subaqueous headings. This clay blanket deposited in advance of the shields, combined with the continuous grouting made with a quick setting concrete over the iron lining, did away with many of the dangers of this delicate tunneling work. The clay came from Haverstraw, N. Y., and was dumped from scows whose position was located by transit men in the high towers of the coal unloading plants of the Long Island Railroad on the Long Island shore and of the New York Edison Company in Manhattan. A total of about 500,000 cu. yds. of clay was deposited on this work. Now that the tunnels have been finished, this clay is being dredged off the river bottom and sent out to sea.

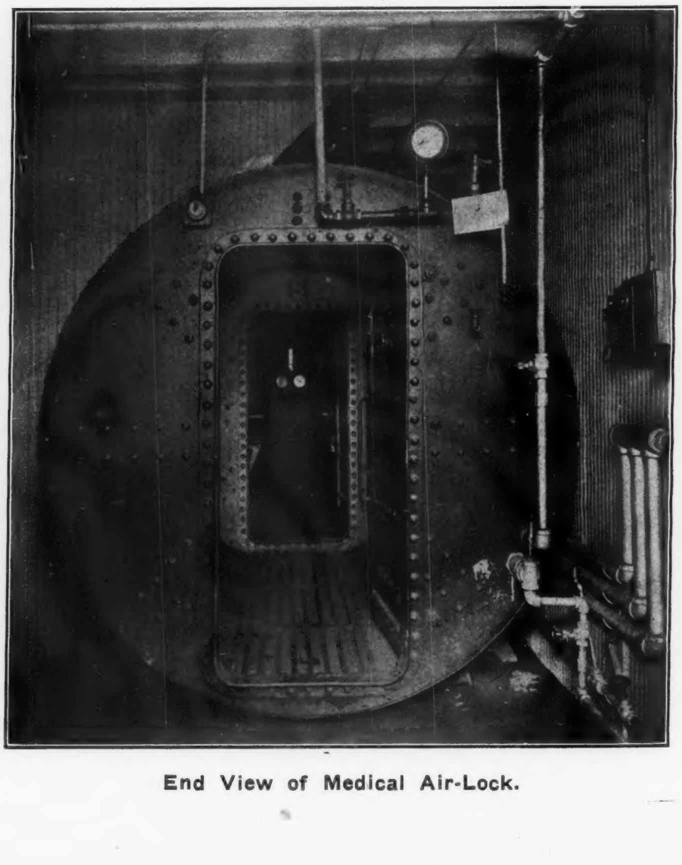
As the shield advanced and the iron lining was erected, cement and lime grout was forced out through grout holes in the cast iron lining to fill up the annular space left outside the lining of the shield and also the roof cavities left in the rock excavation where it had been blasted. For this purpose 250,000 barrels of cement and lime were used. The joints between each segment were caulked with lead or rust caulking to make the tunnels water tight before the concrete lining was placed.

One of the accompanying photographs shows the "medical air lock." On March 20, 1908, the workmen and staff of S. Pearson & Son, Inc., presented to Mr. Moir a brass model of this air lock about 2 ft. 6 in. long by 9 in. in diameter, complete in all particulars. This model was inscribed as follows: "Presented to Mr. E. W. Moir, the maker of the first medical air lock on the old Hudson tunnel, 1890, by grateful 'sand hogs' on the Pennsylvania East river tunnels, New York, 1908." The medical air lock is an air pressure hospital where men attacked with the bends (caisson disease) after coming out into the open air may undergo recompression, which has been found to be the only practicable means of

Erecting Plates in the Tunnel Lining; Looking Toward Shield.



Erecting Plates in the Tunnel Lining; Side View.

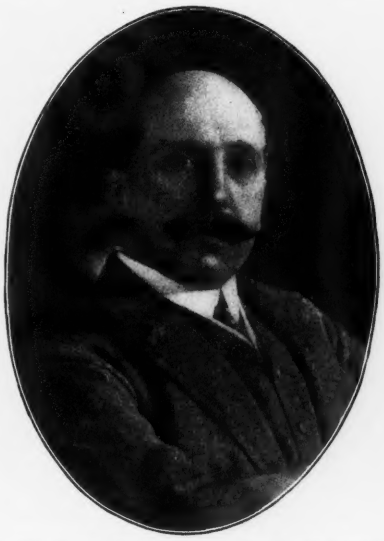


End View of Medical Air-Lock.

relief. In the building of these tunnels there have been three cases of men who, to all intents and purposes, were dead, but after recompression in the medical air lock fully recovered. There have also been cases of men who were paralyzed but were entirely restored to their normal condition after recompression. There are six of these medical air locks for use of engineers and workmen in the tunnels, each one being fitted with a double chamber so that the doctor in charge can pass in and out to his patients without interfering with or interrupting the air pressure of the inner room with the hospital beds. The air lock has compressing and decompressing valves, thermometers and pressure gages.

The chief engineer of this project for the Pennsylvania Railroad is Alfred Noble, who has been responsible for the design and construction of the tunnels. He has been assisted by a board of engineers appointed by the railroad, which originally consisted, besides himself, of Brig. Gen. Charles W. Raymond, chairman; Gustav Lindenthal, Charles M. Jacobs, William H. Brown and George Gibbs. C. L. Harrison is principal assistant engineer and has had particular charge of the alinement of the tunnels.

One of the accompanying portraits is of Sir Weetman D. Pearson, President of S. Pearson & Son, Inc., and also of S. Pearson & Son, Ltd., London, probably the foremost contractor in the world. The second photograph is that of Henry Japp, Director and Managing Engineer of the New York branch of the firm. He was the first engineer, four years ago, for the contractors on the East river tunnels, and has been constantly in charge of the work ever since. The third photograph is of Mr. Moir.


Sir Weetman D. Pearson, Bart., President.


Henry Japp, Director and Managing Engineer.


E. N. Moir, Vice-President and Chief Engineer.

The Executive Officers of S. Pearson & Son, Incorporated.

Electric Night at the New York Railroad Club.

The annual "electric night" of the New York Railroad Club was on March 20. For several years the March meeting of the club has consisted of several short discussions by well-known engineers who have been in charge of important electrical development.

The first speaker was L. B. Stillwell, Consulting Electrical Engineer for the Hudson Companies and the Interborough Rapid Transit Co. He compared the passenger traffic of the Interborough lines with that of steam railroads, showing that the annual passenger mileage in the subway was greater than that on the New York, New Haven & Hartford or on the New York Central, twice that on the Erie, and about the same as that of the Pennsylvania Lines East. The average daily car mileage of the elevated lines and the subway together is 326,357 miles, and the two systems, together, carry an average of 1,519,000 passengers a day. The horse power of the motors on the cars of a subway train aggregate 25 per cent. more than that of a New York Central electric locomotive. Mr. Stillwell then gave some details, illustrated by lantern slides, of the following recently completed under-river tunnels in New York City.

BELMONT TUNNEL.

This tunnel, which is also known as the Steinway tunnel, was built by the New York & Long Island Railroad in the interests of the Interborough-Metropolitan Co. It runs from East 42d street, Manhattan, under the East river to Long Island City. On the Long Island side there is a loop, at which point the cars come to the surface, some of them traveling further east. The operation of this tunnel is to be unique, in that ordinary surface cars are to run through it. For this reason there is a contact rail on the roof of the tunnel. It is a T section, weighing about 20 lbs. to the yard, and is bolted to brackets, which are adjustable. Where the tunnel is tube construction, these brackets are bolted to the flanges of the rings; where the roof is concrete, they are fastened to bolts sunk in the concrete. The rail is supported every 9 ft. A special pantograph trolley is used. This is quite compact, because of limited clearance; it can be compressed so as to be used when the minimum distance between the roof of the car and the contact rail is 8 in. It is similar to that used on the New York Central. On September 24, 1907, the first car was run through the north tube, being only two days after the workers on the tunnel proper had finished their work enough to get out of the way. This was the first car to move under the East river from Manhattan to Long Island under its own power.

EAST RIVER EXTENSION OF THE INTERBOROUGH.

Because of limited space, a special design of third rail is used in this tunnel. It is an inverted U section and is placed 26 in. from the gage line. This distance is criticised because it may not be far enough away to allow cars of other lines to be interchanged in case it is desired, in future, to operate cars of the New York Central, the Long Island Railroad, etc., over the Interborough. [The New York Central distance is 28¼ in. and the Long Island 27½ in.] A special design of bonding is used. The slugs of the bonds go through the rail vertically, there being two plugs, arranged tandem, at each rail end.

For pumping out water in the East river tunnel, there are five sumps. There are now six 6-in. pumps, there being two pumps in the sumps at the bottom of the dip, each having 600 gal. capacity per minute. These sumps are in chambers 7 ft. x 14 ft. placed between the tubes. The pumps discharge through individual pipes to sewers in Manhattan and Brooklyn.

The piston action of trains is sufficient for normal ventilation. If three trains were stalled in one tunnel, people in the middle train would not suffer discomfort for an hour. An auxiliary ventilating plant, however, is installed for use in such emergency. There are air flues at each end of the tunnel, through which air is forced in in the direction of traffic at the rate of 43,000 cu. ft. per minute against the assumed normal pressure in the tunnel. However, this rate will probably be affected by the direction of the prevailing winds. The operation of the ventilating system is controlled by the despatcher at Bowling Green. At each manhole there is a telephone, a fire extinguisher and a fire hose, which can be coupled to the water lines running through the tunnel.

HUDSON & MANHATTAN.

The grades in this tunnel run as high as 5 per cent. All the cars used are motor cars (in the Interborough subway, motor cars and trailer cars are alternated in making up a train), and by reversing the motors the cars can be surely held on any grade.

Hugh Hazelton, of the Hudson Companies, described the construction of the Hudson & Manhattan cars (*Railroad Gazette*, June 14, 1907). The Hudson & Manhattan when finished will have 19 miles of track. Of this, six miles are now in operation, and six more are excavated and ready for bench walls, and are expected to be in operation by the end of the current year.

In the Hoboken terminal there are two station tracks for each incoming track, so that one train can come in and discharge passengers as another is being loaded. This will make possible a 1½-minute headway. There are separate loading and unloading platforms in all three terminals. The lights are operated by alternating current direct from the power house, or by direct current from the third rail. This rail, which is similar to that in the Brooklyn

extension of the Interborough, is low in manganese and carbon. Its conductivity is one-eighteenth that of copper. The protection over the rail is of jarrah wood, from Australia. The boards are 2 in. x 9 in. x 9 ft. It is heavier and a little harder than oak. Its particular value lies in its fire resisting qualities. It will stand the flame of a blow torch for 11 minutes before burning through, as compared with oak, eight minutes, and pine about two minutes. Also, jarrah wood will not keep on burning after the torch is taken away. The tunnel is lighted by two rows of lamps, spaced 60 ft. apart on each row. They are alternate, so that there is a light every 30 ft. The power house is at Washington and First street, Jersey City. There are two 3,000-k.w. generating units. At present, however, power is being acquired from another source.

J. M. Waldron, Signal Engineer of the Interborough Rapid Transit, described the signal system of the Brooklyn extension. This was described in an article in the *Railroad Gazette* of February 28, 1908.

NEW YORK CENTRAL.

W. J. Wilgus spoke of the advantages of electrification as found from the experiences of the New York Central. Since July 1, 1907, all New York Central trains have been electrically operated to and from Grand Central Station. The system has proved successful from the operating, the engineering and financial standpoints. There are a number of "by products" of the electrification of steam lines. With electric operation, it is possible to make use of the "air rights" of the corporation; that is, to build office buildings over terminal yards. The New York Central property at the Grand Central Station terminal is worth $50,000,000 more under electric operation than under steam operation, taking into account this possibility of erecting revenue producing buildings on it. Under electric operation, also, money is saved in the lighting of yards and terminals. As long as propulsion current is there, it is easy to provide additional current for these other purposes. The New York Central, in this way, will save $200,000 a year. There is also plenty of current available for labor-saving devices at freight terminals; for example, the operation of float bridges, unloading machinery, etc. A power house is designed so that it can take care of peak loads. Between these points of maximum requirements, power for other purposes can be turned out at a cost about equivalent to the cost of burning coal under the boilers. Another advantage is the economy of switching by electricity. Mr. Wilgus knows of one yard in which $114,000 a year was saved in this way. Also, when there is a continuous current-carrying conductor along the road, it is possible to use other devices, such as automatic stops. The use of automatic stops makes it unnecessary to have more than one man at the front end of the train, since in the electric locomotive or the front car of a multiple unit train the second man has nothing to do except stand ready to take the motorman's place in case of trouble. Automatic stops also take the place of surprise checking to correct careless overrunning of stop signals.

NEW YORK, NEW HAVEN & HARTFORD.

W. S. Murray, Electrical Engineer of the New York, New Haven & Hartford, emphasized the fact that the steam locomotive was in no danger of being relegated to the scrap heap. The bases for determining the relative efficiency of different systems of motive power are reliability of service, fixed charges and operating expenses. One pound of coal burnt at the Cos Cob power house is equivalent to two pounds burnt in a steam locomotive. The same ratio applies to the locomotive mileage of steam and electric locomotives. The mistakes in the design of the New Haven electric engine are not fundamental. The troubles the road has had are due to the fact that electrification was only partial, this situation bringing in problems which the New York Central, with its complete electrification, did not have. The company has on file orders for multiple unit cars, but these will not be placed until the electric locomotive has been perfected. A few experimental multiple unit cars have, however, been ordered.

ELECTRIFICATION IN 1907.

George Gibbs gave the following list of what had been done during the year in electrification and other important developments in electric traction: The New York Central began full electric operation in New York City on July 1, 1907; the New York, New Haven & Hartford (the first alternating-current electrification of a steam road in this country) July 22; part of the West Shore, June 15, this being particularly interesting as giving an opportunity to compare the results of direct competition with trolley lines; Rochester division or the Erie, June 18; Belmont tunnel, September 24; Brooklyn tunnel, January 27, 1908; Hudson & Manhattan tunnel, February 25. Other electrification projects definitely decided on are: The Cascade tunnel of the Great Northern, and the line over the Bitter Root mountains on the Pacific coast extension of the Chicago, Milwaukee & St. Paul. This line is 54 miles long and the grades on each side of the summit are 1.7 per cent. Current is to be generated by water power. An advantage of electrification in timbered country is that danger of forest fires is lessened.

Walter C. Kerr, Vice-President, Westinghouse, Church, Kerr & Co., said that he wondered that so little had been done in actual electrification. A deterrent is the great first cost of the electrifications which have been proposed. The electrification of tunnels is particularly attractive. Another field is the electrification at terminals in large cities. Those of this class which have been completed or are under way all connect with tunnels, e.g., the New York Central, the New Haven, the Pennsylvania, etc. The other fields for electrification are branch lines and heavy mountain grades. Everybody admits that electrification is theoretically advisable, but the first cost is the great hindrance. It is now time to reduce costs, not only of electric apparatus, but the other costs entering into such installations. When a new road is built to be operated by electricity, from 15 to 20 per cent. of the cost is for electric material. When a steam railroad is electrified, 75 per cent. of the cost is for electric material. The turbine has cut in half the cost of generating power. Heating and coal handling also cost less than before. These savings are offset by the increased cost of labor and material; and this increase makes still more necessary the economy in handling just mentioned. There has been much technical advancement; what we need now is attention to costs.

ELECTRIC ENGINES OF THE SPOKANE & INLAND.

B. G. Lamme, of the Westinghouse Electric & Manufacturing Co., spoke of the freight locomotives of the Spokane & Inland. Direct current is used in Spokane and 6,600 alternating current outside of the city. There is a 2-per cent. upgrade eight miles long leading out of the city. Beyond that the country is level, supposedly, but really so rolling that 40 per cent. of the line is on a 1½ per cent. grade. The first order was for 21 passenger motor cars and eight freight locomotives. The nominal rating of the locomotives was 600 h.p., there being four motors of 150 h.p. one-hour capacity to each locomotive. The engines have two swivelled trucks. The maximum tractive effort is 15,000 lbs., and continuous effort, 7,000 lbs. On the first grade out of the city the motors heated so that their efficiency for overcoming following grades was reduced. On these first locomotives the cooling fans were geared to the motors; on the later ones they were equipped with fans operated separately. In the first locomotives, the fans, of course, moved slowly and supplied less air to the motors at just the times when the motors needed cooling most. At one point on the line the locomotive has to stop for a turnout on a steep grade. The conclusion drawn from the experience with these locomotives was that a one-hour rating will not do. So in the later locomotives, the tractive effort rating was made 16,000 lbs. continuous and 25,000 lbs. one-hour or maximum rating. The one-hour rating will not do for long distance hauling. The steam locomotive develops a certain maximum power and keeps it up indefinitely. The electric locomotive has no maximum except the maximum of the power house. Its tractive effort must be adjusted to the heating of the motors. Therefore for freight service the basis of the system should be continuous tractive effort, with an emergency high rating. The new locomotives on the Spokane & Inland are satisfactory; the old ones are also, but they cannot haul such heavy trains. The speaker was recently asked how soon he believed the steam locomotive would be supplanted by the electric locomotive. He therefore did some figuring. He decided that if all the electric companies in the country began now to build nothing but electric locomotives, letting all their other work go, it would take from 10 to 20 years to replace the number of steam locomotives now in service, taking no account of the additional steam locomotives that would be built in the interim.

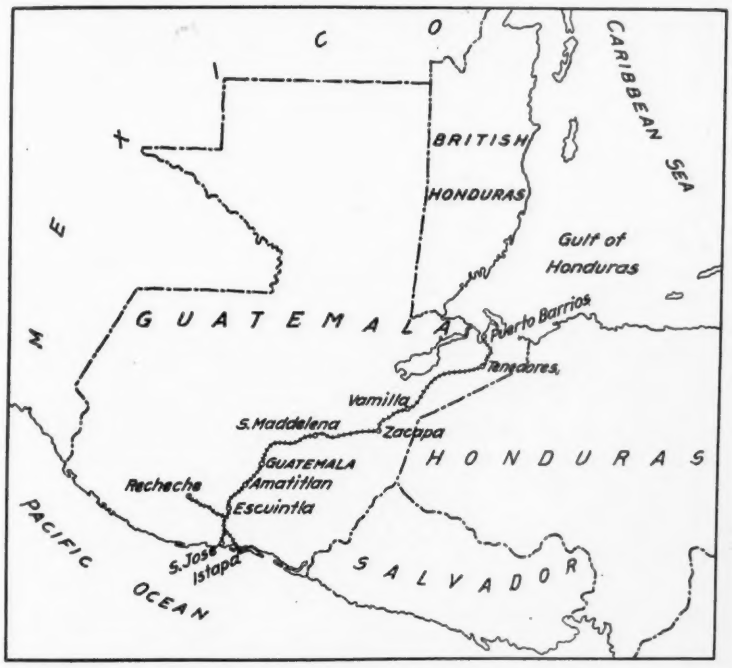
William McClellan, Consulting Engineer, said that the electrical engineer has shown that electric locomotives and multiple unit cars can do all the work which steam equipment does. The difficulties which have been already surmounted in the tunnels under the North and East rivers, New York, and in the New York Central and the New Haven installations, are worse than any that will be met in the future. Cost prophecies will be fulfilled. Electrification can provide greater capacity than can changes of location, including deep cuts, etc., on steam railroad mountain divisions. Recent progress in steam locomotive design is due in great measure to the competition of electric equipment. The question as to what system to use, i.e., d.c., a.c., etc., as well as the cost, is the reason why more electrification has not been carried out. The systems are as follows: Third rail, single-phase, three-phase, 1,200-volt d.c. and the gasolene electric car. Anyone of these may be best and everybody is afraid to definitely choose one, as it may later prove to be the wrong one. The electrical engineer is likely to be too technical. He needs the broader view which he gets by working with the steam railroad engineer. When the electrical engineer gets broadened, the necessity of which is becoming more generally recognized, much will be done.

The passenger traffic through the Simplon Tunnel has fluctuated greatly and was largest in August, 1906, the third month of its operation. In that month 42,622 passengers were carried through

the tunnel. The number fell to 14,545 in November of that year, and to 10,106 in the following January. The largest number in any month since has been 34,500. The freight traffic has grown rapidly but is still small. The largest in 1906 was 5,658 tons in October. For the first five months of 1907 it was about 44,000, swelled by a blockade of the Mont Ceni route. Since May it has been 5,000 to 6,000 tons per month. The first year the gross earnings were $190,000.

The Guatemala Railroad.

The republic of Guatemala has until lately been as far away commercially from Europe and the eastern United States as the Hawaiian Islands, because access to the city of Guatemala, a beautiful city of 100,000 inhabitants, the capital and the center of almost the entire trade of the country, has been possible only from the



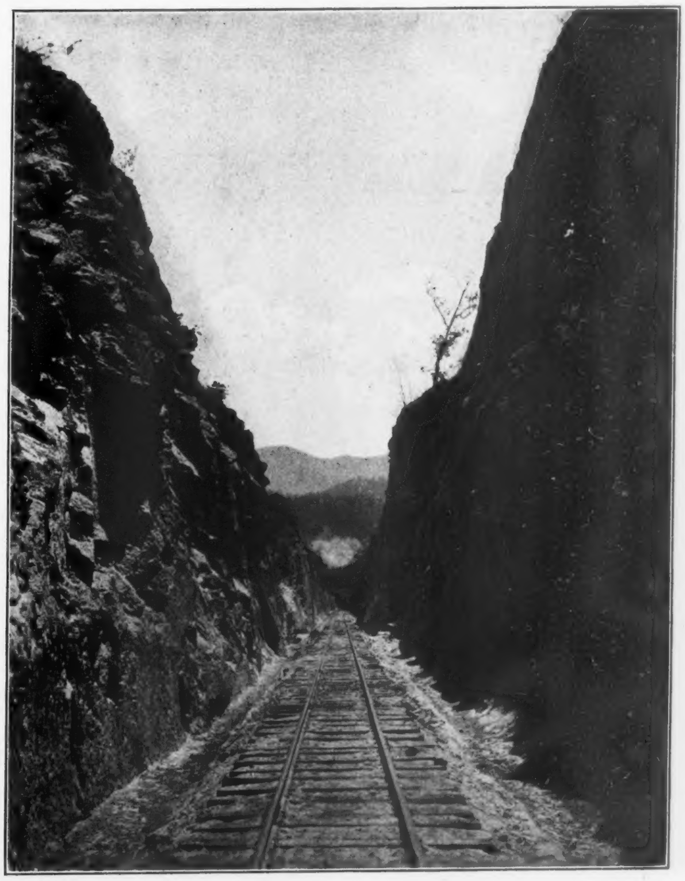
Map Showing Location of Guatemala Railroad.

Pacific side. On that coast Guatemala has no harbors, therefore vessels have to lie in the offing and handle freight and passengers to and from the shore by lighters and small boats. The chief commodity exported, coffee, is as yet mostly produced on the west slope of the Cordilleras between the city of Guatemala and the Pacific ocean. This has hitherto been lightered to vessels, then carried 1,000 miles south along the coast to Panama, there transferred to the Panama Railroad and carried across the Isthmus to Colon, two to four weeks being required for this part of the trip. At Colon a transfer to vessels on the Atlantic side had to be made. In addition to the expense of lighterage and transportation there has

Azacuajulia Viaduct; Guatemala Railroad.

been a heavy loss on coffee carried by this route through exposure to water in the numerous transfers and through bleaching and deterioration resulting from its long carriage in a hot climate. A similar disadvantage has attended all of the other business of Guatemala in and out. The only available routes for passengers between Guatemala City and the eastern United States and Europe have been by the way of San Francisco or Panama, and the time involved between Guatemala City and New York has been three weeks at least and usually more.

This unfavorable situation of Guatemala has always been a heavy handicap on development of its trade. With the purpose of bringing the country within easy reach of the world the government of the republic about 35 years ago took steps toward construction of a railroad from the Atlantic side to the capital, nearly 200 miles, and had succeeded up to 1896 in building 134 miles of line from Puerto Barrios, the principal harbor on the Atlantic coast, toward the city of Guatemala. However, when the difficult mountain section was reached, funds gave out and work was suspended. Several unsuccessful attempts were subsequently made to complete the line. Finally in 1904 a concession was granted to Minor C. Keith, Vice-President of the United Fruit Company, and Sir William C. Van Horne, Chairman of the Board of the Canadian Pacific Railway, both of whom had had much experience in building railroads in the tropics, the former in Costa Rica and the latter in Cuba. They

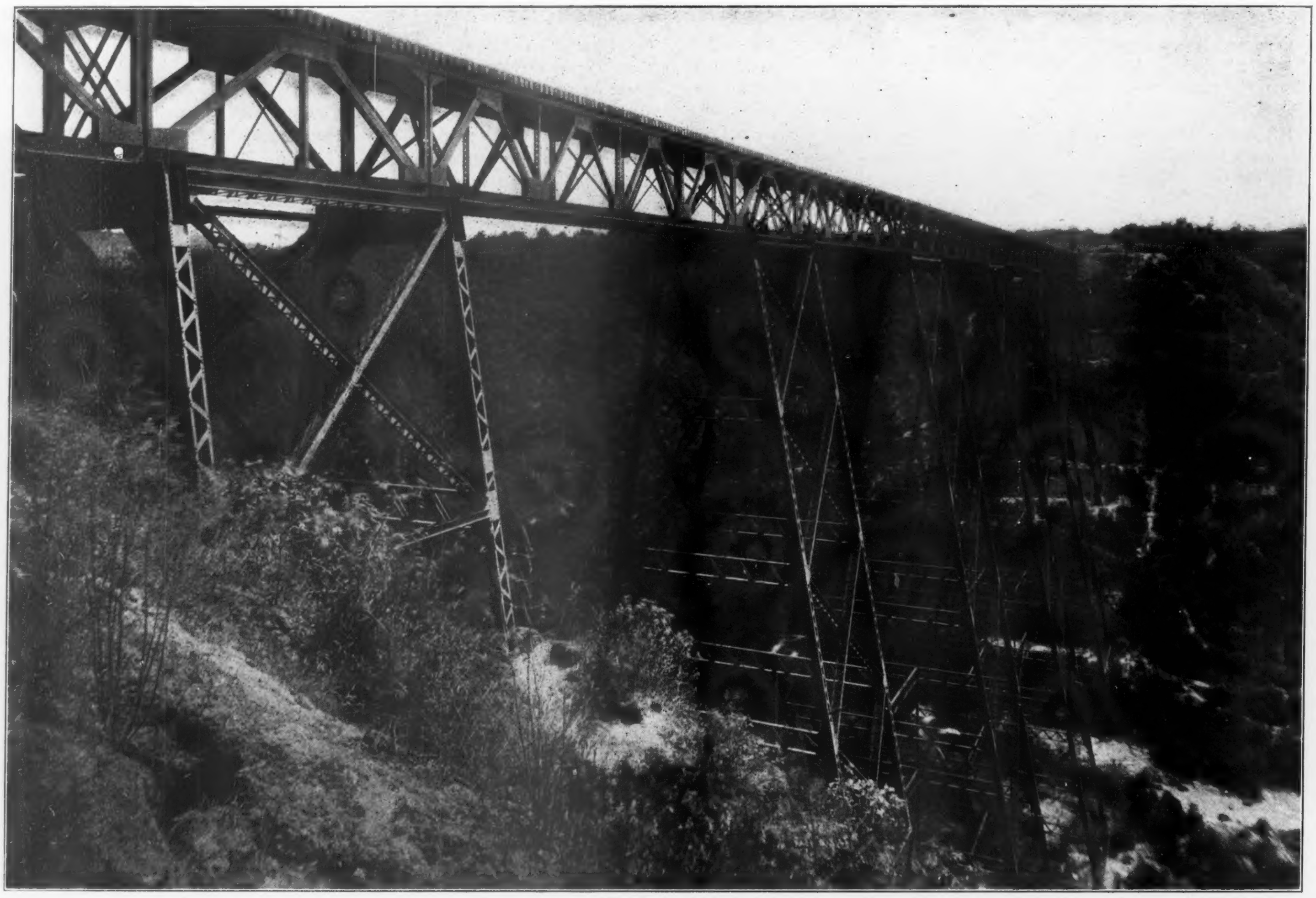


Rock Cut East of Azacuajulia.

associated with them General Thomas H. Hubbard, President of the Guatemala Central Railroad, the 75-mile road which connects the city of Guatemala with the ports of San Jose and Istapa on the Pacific coast, and immediately set about the work of construction. The Guatemala Railroad was finished on January 10, 1908.

The new work was among the summit peaks of the Cordilleras and was attended with many difficulties, among which were numerous deep ravines which had to be crossed by great bridges, some of which are shown herewith. There are also numerous shorter through truss bridges, and masonry arches have been freely used. At many points protection walls of masonry topped by rubble work are built to protect the road against the mountain streams. All tunnels are lined throughout with masonry. The whole work was made permanent throughout: no wood was used except the creosoted cross-ties. While the new work was going on, the old section of the line had to be almost entirely rebuilt to bring it, for economy in working, up to the standard of the new section. The railroad is now in operation and Guatemala is relieved of her handicap.

Freights which before required from two weeks to a month to be handled between Colon and the city of Guatemala may now be handled between that city and Puerto Barrios in one day, and passengers may now reach Guatemala City from New York inside



Las Vacas Viaduct, Near the City of Guatemala.

Callejon Viaduct; Guatemala Railroad.

Trapich Fill; Mountain Section of Guatemala Railroad.

Plantation Track of the United Fruit Company on the Guatemala Railroad.

of a week instead of from three weeks to a month. Moreover, new and fast steamers are being built by the United Fruit Company to shorten the time between Guatemala City and New York via New Orleans to four and a half days.

The opening of this new line will give a great impetus to the development of Guatemala, which already has a population of 1,700,000 and great natural resources in its rich soil, its forests and its mines. It is expected that the entire coffee trade of Guatemala will very soon be turned through Puerto Barrios, and the great bulk of the import and export trade will immediately be handled that way.

An important source of revenue to the railroad will be the carriage of bananas, the plantings of which now being made by the United Fruit Company along the road already require 40 miles of plantation railroad tracks. The banana plantation of the United Fruit Company now extends for 28 miles continuously on both sides of the main line of the road. The extent of this industry is realized by few people in the United States. Some idea of it can be conveyed by the statement that the United Fruit Company employs 125 steamships in this trade. The low lands of Guatemala extending back from the coast on the Atlantic side are perfectly adapted to growing bananas, and Puerto Barrios has the advantage of being a day to a day and a half nearer to New Orleans and the other principal distributing markets than Port Limon in Costa Rica, which has hitherto been the chief source of supply.

A branch line to the frontier of Salvador is projected which would pass through the most important mining district in the country, where gold and silver mining has been carried on for nearly a century, although on a small scale owing to the impossibility of bringing machinery across the mountains.

The successful carrying out of Guatemala's great railroad enterprise has been mainly due to the energy, foresight and courage of President Estrada Cabrera, whose keen interest, liberal support and fair dealing are spoken of by the men who built the road in the warmest terms. They state that from the beginning to the end of their work, peace and quiet have prevailed in Guatemala and that the sensational reports which have from time to time been published in the United States and Europe have been almost wholly without foundation. During this time the troubles between some of the other Central American states have made President Estrada Cabrera's position a most difficult one, but with admirable wisdom and tact he has kept his country clear of all complications.

The Attendance at the Maintenance of Way Convention.

Secretary Fritch, of the American Railway Engineering and Maintenance of Way Association, has prepared an analysis of the attendance of the recent convention, which shows it to have been fully representative of the engineering departments of American railroads. The total number of members who registered during the meeting was 281, an increase over 1907 of 70. This figure is larger than that given in our report of the convention last week due to the fact that a number of new members who were voted in during the convention have properly been included in the total attendance. There were present 51 chief engineers, nine assistant chief engineers, 32 engineers maintenance of way, 11 principal assistant engineers, 19 bridge engineers, 26 division engineers, 25 assistant engineers and 15 signal engineers. Ninety-one railroads with a total of 166,429 miles were represented. The following list gives the complete classification of the members in attendance.

Presidents	3
Assistant to president	1
Vice-presidents	3
General managers	3
Assistant to general manager	1
General superintendents	2
Division superintendents	5
Chief engineers	51
Assistant chief engineers	9
Engineers maintenance of way	32
Principal assistant engineers	11
Bridge engineers	19
Division engineers	26
Engineers bridges and buildings	3
Assistant engineers	25
Inspecting engineers	7
Resident engineers	7
Locating engineers	2
Terminal engineers	4
Inspectors of maintenance	2
Engineers of construction	3
Signal engineers	15
Chemists	4
Chief draftsman	1
District engineers	2
Designing engineer	1
Tunnel engineer	1
Superintendent of track and roadway	2
Supervisor of timber preservation	1
Rail inspector	1
Maintenance of way accountant.	1
Railroad architect	1
Editors of railroad journals	2
Professors of universities	8
Master carpenter	1
Civil, consulting and contracting engineers	21
Total	281

Re-Lining Long Curves by Running Trial Curves.

BY R. W. WILLIS,

Engineer Missouri District, C., B. & Q.

The following method of re-lining curves takes the place of running out tangent intersections or meandering the curve. It is to be used on long curves. In most offices there are old notes which give the original degree of curve. For the trial curve, use the curve shown in these old notes, unless the degree of curve is such that it should be spiraled. In such a case, the degree of the trial curve should be increased so that the difference between its external and the external of the curve shown in the original notes will be about one and one-half times the offset which would have to be made from the tangents in putting in a spiral. This ratio depends somewhat on the length of the curve.

Take a point on one of the tangents (on an offset tangent if the curve is to be spiraled) as near the P. C. as possible. The curve is very liable to run off the bank after 500 ft. or more have been run; when this happens, measure the distance from it to the center of the track, divide by the sine of twice the deflection angle and move the P. C. ahead or back accordingly as the curve ran off the inside or outside of the track. The trial curve run from the corrected P. C. will not in most cases be more than 3 ft. from the tangent when it reaches the P. T. At the turning points, which should be made every 500 ft., put a tack in a tie either ahead or back of the turning point so that a line to the tack from the turning point will be parallel to the tangent from which the curve was started. By stretching a string from the turning point to the tack, a new turning point, as explained later, can be located without setting up the instrument.

Near the end of the curve, take a line parallel to the track and passing through the last station on the trial curve; the total deflection angle is equal to half the angle between this parallel line and the tangent to the trial curve, added to or subtracted from the deflection angle for the last station, according to whether the central angle of the curve has been increased or decreased.

It usually takes 10 or 15 minutes to get this total deflection angle. The central angle should check to within a minute of the angle which would be found if tangent intersections were run out. The trial curve can usually be run very quickly; that is, as fast as the men can chain accurately and the transitman make deflections. When the P. T. has been set, measure the distance from it to the center of the existing track, or to the offset tangent if the curve is to be spiraled. Divide this distance by the sine of the central angle. The quotient gives the amount which the P. C., the turning points and the P. T. must be moved to be in their true positions. They are moved on lines parallel to the tangent from which the curve was started, and the movement is ahead or back according as the P. T. of the trial curve fell inside or outside the tangent.

This gives points on a true curve every 500 ft., so that in setting stakes it is not necessary to set a stake more than 250 ft. from the instrument. The tacks must be accurately placed in the stakes. The instrument does not have to be set up oftener than if the curve were run by the usual method. If it be found necessary to change the degree of curve so as to fit the track as close as possible, it can be easily and quickly done by figuring exactly how much the external of the trial curve should be shortened or increased. A point is then set for a fore-sight on the external by measuring from the center point on the trial curve, and from the trial curve it is easy to establish the P. C. and P. T.

On very long curves, any desired point can be fixed by the following method: Multiply the radius of the curve by the versed sine of the angle on the trial curve between the central point of the curve and the point to be established; also multiply the radius by the versed sine of the corresponding angle on the existing curve. Taking the difference between these two products, and allowing for the difference in length of the external of the trial curve and of the desired curve, any point can be established by measurements from the trial curve. If a Searles spiral is used, the trial curve should be started at the end of the spiral next to the curve. The point should be found by taking the offset from the tangent for the end of the spiral so that the point would fall slightly inside the center of the track, depending somewhat on the degree of the curve.

The objections to the usual method of re-lining curves are: the time required, and the fact that while the curve will fit the track at the center point, it may not fit it at any other point, at least not to the best advantage. With a great deal of figuring, quarter points can be established which will make the curve fit the track quite closely, but on long curves, where several courses are necessary, this takes an enormous amount of figuring and multiplies the chances of error. A good curve runner, using the trial curve method described, should establish and stake 3,000 ft. of curve a day. I have established and staked 5,000 ft. of curve in a day and had some little time to spare.

Bolt Locking.

BY W. H. ARKENBURGH.

The specifications for mechanical interlocking at present under consideration by the Railway Signal Association provide as follows:

"91. All facing point switches, derails, movable point frogs, on high-speed routes shall be bolt locked with signals governing such route."

"In all cases where switch and lock movements are used, bolt locks shall also be used."

"92. The switch bar on all bolt locks shall have an independent connection to switch point."

"93. The signal bar on bolt lock shall * * * be a part of the line and not lugged or looped in * * *."

A bolt lock is a device whereby a signal governing a route blocks and is locked by any or all switches in the route, that is, a proper position of the switch is made necessary before the signal can be cleared. Generally, only facing point switches and high-speed signals are bolt locked.

The necessity for a bolt lock lies in the supposed unreliability of the facing point lock and the switch and lock movements. The former is usually some form of plunger actuated by a lever distinct from the switch lever, designed to pass through and hold in position a rod attached to the first or bridle rod of switch. It is obvious that should the connection between the plunger and the lever break, after the plunger had been withdrawn, the switch could not be locked. Also, with the present almost universal method of using but one plunger which will pass through either of two holes in the lock rod, according as the switch is normal or reversed, if the switch connections should fail, the plunger would relock the switch in the same position as before it was withdrawn. The switch and lock movement is a device for throwing and locking a switch with one lever and line of pipe. If any part of the connection should break the lever could be moved without any effect on the switch.

To provide safety even should any of the above events take place, bolt locking has been resorted to. In general practice a bolt lock consists of a notched bar extending from the bridle rod of the switch and intersecting at right angles a similar bar inserted as an integral part of the signal connections. The notches are so arranged that only when the signal is properly set can the signal bar pass over the switch bar.

There are many so-called bolt locks in use which consist of nothing more than a facing point plunger and casting, the plunger lugged to the pipe line and passing through an ordinary lock rod connected to the switch when the switch is properly set and the signal cleared. Only one hole is provided so that if the switch is not right the plunger cannot enter and consequently the signal cannot be cleared. This sort of construction is wrong in one very important particular. If any of the pins holding the plunger and its connections should fall out or be removed the apparatus is inoperative. In other words a failure of the apparatus produces a dangerous condition. This is what the specification aims to do away with. If two notched bars are used, and the signal bar is made a part of the line, any failure of this bar or its connections will prevent the signal from being cleared.

It has been customary in many cases where the interlocking station is located between a signal and a switch governed, to extend the signal pipe line both ways from the lead out through a double jaw in order to bolt lock the switch. Theoretically this is wrong, for should any part of the line between the lead out and the switch break down a false signal might be given. A strict interpretation of the specification forbids this being done, but careful consideration should be given to the conditions necessary to allow a false signal to be given. First, the switch connections must fail allowing the switch to be in a position not corresponding to that of the lever, or the facing point lock connections must fail, allowing the switch to stand partially open, provided it is sufficiently out of adjustment, with the facing point lock lever reversed. Second, the bolt lock connections between the leadout and the switch must fail. *Both* the first and second conditions must occur at the *same time*. The probability of this combination of circumstances occurring is extremely remote. Now there is no reason why the pipe line from leadout to bolt lock cannot be made absolutely continuous with tang end riveted and screwed connections throughout. The matter of adjustment can be taken care of by a turn buckle and there is no need to insert a compensator, for the expansion and contraction of 1-in. pipe amounts to only .008 in. per 100 in. per 1 deg. F., and this could be provided for in the length of the notch in the signal bar without danger of clearing the signal to such an extent that it would be accepted by an engineman. The only alternative solution of the problem is to run the signal pipe line first to the farthest switch governed, returning thence by means of cranks through bolt locks to the signal. In other words run the line all around the plant. It is perfectly evident that this method is out of the question owing to cost and general complications in plants of any size. It is possible, however, to meet the situation by electrical means. Before describing such it will be well to consider some weak points of present practice which are negatively allowed by the specifications, but are far more dangerous than some of those it condemns.

First, consider the switch bar of a bolt lock and its connections. Almost universally, this consists of a rod at one end of which is the notched bar and at the other a jaw. This rod is attached to the *lug* on the bridle rod or switch point by a *pin* through the jaw secured by a *cotter key*. Lugs are secured to switch point by bolts and nuts. Very often the notched bar is also secured to the rod by a jaw and pin. Suppose a pin falls out or the bolts break or are removed (both have occurred), of what use is the bolt lock? If the rod is fastened to a lug on the bridle rod, there are four more chances of failure; the switch point lug bolts and the two pins holding the bridle rod to the switch point lugs. Sometimes the bolt lock connection to a switch passes across several tracks, through transverse pipe carriers. The failure of one or more of these carriers might very well allow the rod to buckle and produce a dangerous condition. These transverse pipe carriers are not nearly so substantial as the regular pipe carriers.

The specifications require bolt locks only on high-speed signals. Theoretically and practically one signal is just as important as any other at an interlocking plant, and the failure of one end of a crossover might very well cause a side or head-on collision, through clearing an unboltlocked dwarf signal.

It is a fact that some roads are experimenting with, and to a certain extent, have even adopted rigid switch and lock rod fittings. That is to say bridle and lock rod together with the switch point lug are made all in one piece, except that sometimes a turnbuckle is introduced for adjusting. The same is done with a throw or second rod. Here, of course, the cage must be retained. With this arrangement pins and cotters are done away with in one of the places where they are most dangerous. If this form of construction were carried one step further so as to include the switch connection to the bolt lock, making it a part of the bridle rod, most of the weak points of present bolt locking practice would be eliminated. It seems pertinent to remark in this connection that if the plunger of the facing point lock were attached to the line by means of a riveted tang end joint instead of by a jaw and pin, another source of danger would be removed.

Electrical bolt locking can be accomplished in a number of ways. Where power operated or semi-automatic signals are used, the control circuits for these can be broken through controllers on the various switches. A strict interpretation of the specifications would require a mechanical bolt lock even where a power operated signal is used. This would seem absurd on account of the expense of the pipe line and connections, especially if it would be necessary to run all around the plant. Moreover, any failure of the mechanical bolt lock would not prevent the signal from being cleared. It is really unnecessary, as breaking the control circuit is just as efficient a method. In any electrical scheme, however, the tendency is to locate the battery for all apparatus in the tower and to run, if conditions seem to require it, to one end of the plant and back again through the various instruments past the tower to the apparatus controlled. This is even worse than running both ways from the leadout to reach a bolt lock, unless the wire between the battery and the first instrument is kept absolutely insulated from the rest of the circuits. This is because a loop is established and any break-down of the insulation between the battery feed and another part of the same or another circuit will cut out all intermediate instruments. Every signalman has had experience with nails through trunking, dry and wet rot on the insulation, cracks in the insulation and numerous other phenomena of a similar nature. It is hardly possible that anyone will claim that as much dependence can be placed on the insulation of a wire as on a pipe line for the operation of signaling apparatus. Short circuits to the common return frequently lead to similar results. The safe method is to insulate the main positive and negative feeds from all other circuits either in separate trunking or on a pole line, or put a battery at each end of the plant.

A safer method of electrical control of power operated or semi-automatic signals is to make both the plunger of the facing point lock and the switch itself control the circuits. When this is done, assurance is given not only that the switch is properly set but also that it is locked, before a signal can be cleared. This method can be applied also to electric selection of signals by the switch.

Electric locks, controlled by either method described, can be attached to the signal lever latch to lock it normal, unless the route is properly set. This is an efficient method, but is more expensive than breaking the control circuits. It is really the only electric bolt locking feature that can be applied to a purely mechanical plant. If route levers are used, as they sometimes are, especially where extensive approach and detector locking devices are employed, the lock can be applied to the route lever to lock its tappet reversed. Such a scheme would be far more liable to tie up a plant than the former, in case of failure, for the route would be locked as set up. It is, however, always possible to provide a release. The term tappet as here used is meant to include any device actuated by the movement of the lever latch.

Electric locks, however controlled, when used for bolt locking, should not be attached to a facing point lock lever only. For,

should the connections between the lever and the lock break down, no protection could be secured. As an additional safeguard, to lock the switch with the signal clear, locks on the tappet of the facing point lock lever, as above, might prove very efficient, but would seem unnecessary, especially where approach or route locking is employed. When so applied the circuit would be controlled through a normally closed circuit breaker on the home signal arm.

It would seem that in the present state of the art of signaling the whole subject of bolt locking has an exaggerated importance. There is certainly more room for improvement in facing point lock construction and switch fitting; and this might, in the end, render bolt locks unnecessary. The bolt lock is at best a cumbersome and expensive device. The only excuse for its existence is an attempt to overcome defects in other apparatus which might better be improved.

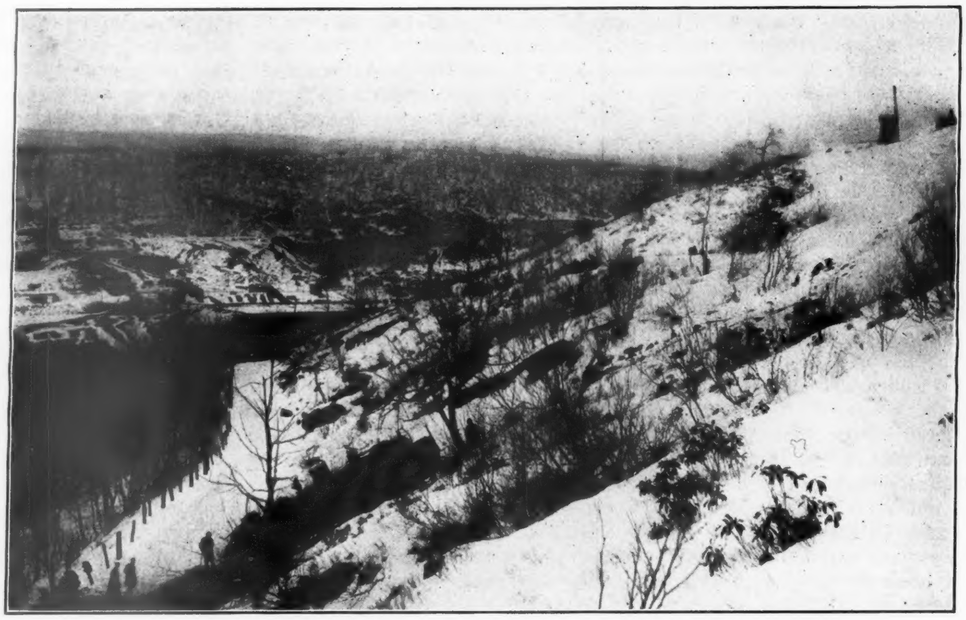
Locomotive After Derailment.

Hauling a Locomotive Up a Mountain Side.

On February 3, 1908, passenger train No. 604 on the Erie division of the Pennsylvania Railroad, hauled by engine 555, was derailed at the top of the mountain just before entering the village of Frackville. The train was running at 30 miles an hour when the engine suddenly left the track and plunged down the mountain side to a wagon road about 200 ft. below. The engineer was instantly killed; the fireman escaped without injury.

When the engine left the track, the coupling between the tender and the first car broke and the passenger coaches passed safely along the track and stopped a few hundred feet beyond the point of derailment. The tender turned a somersault over the engine and landed beyond it in the wagon road, completely blocking it. The engine stood on its wheels at an angle of 45 degrees with the horizontal, with the pilot buried in the ground.

The mountain side was so steep and the engine so far away from the track that it was very difficult to get it back again. Several attempts to pull it directly back up the slope with two 50-ton steam derricks failed. It was finally decided to lay a track from the wrecked engine about 200 ft. along the public road to an old inclined plane which ran to the top of the slope.

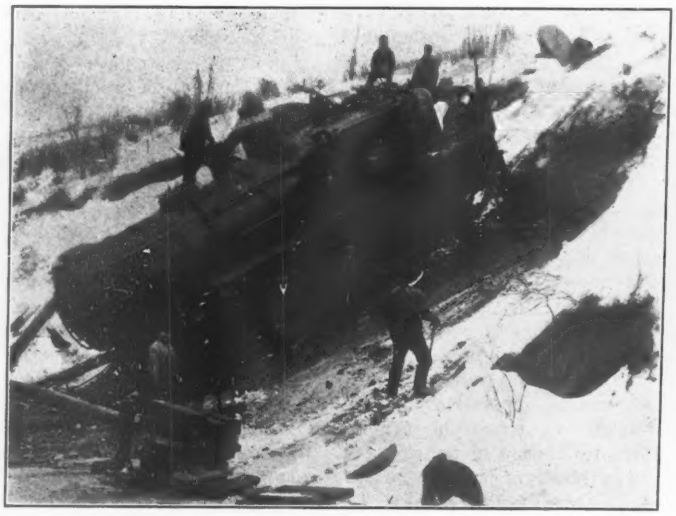


Track (Upper Right Hand Corner), Engine at Foot of Slope, and Highway.

About 80 years ago Stephen Girard built the Danville & Pottsville Railroad, which consisted of stretches of comparatively level track connected by inclined planes up which the cars were hauled by cables. The road was projected from Danville, on the northern branch of the Susquehanna river, to Pottsville, but was built only from Girardville to Pottsville, being used to develop the resources of the Girard estate. No. 5 of these planes is near the point of the Frackville derailment.

After the prostrate locomotive had been turned around by hydraulic jacks, so that it was parallel with the road, it was possible by using long cables attached to the derrick at the head of the plane, to pull it about 200 ft. along the wagon road on the temporary track to the foot of the plane. From this point the difficult and dangerous task of retracking the engine began. The plane was on an angle of about 45 degrees from the horizontal and about 350 ft. long. The two steam wrecking derricks, of 50 tons capacity each, were placed at the head of the plane on the main track, each derrick having a line of steel cables strung from it to the locomotive so that each derrick worked independently of the other. This was done so that one derrick could hold the engine in case of accident to the other. On account of the long distance the engine had to be pulled up the plane, five cables, each 50 ft. long, joined together, were used on each derrick.

When everything was ready, the signal was given to each der-



Locomotive Being Turned Parallel with Highway.

Locomotive at Foot of Plane after Having Been Pulled Along Highway. Telegraph Pole Marked "X" Shows Where Derailment Occurred.

rick to pull and the heavy engine started to move slowly up the plane. After it had been pulled 50 ft. a stop had to be made. While one derrick held the engine, the other took out a section of its cable. The start up the plane was made at 10 a. m., Sunday, February 15, 1908, and at 12:45 p. m. the locomotive was safely alongside of the main track at the top of the hill. The accompanying photographs show the locomotive at various stages of this work.

Locomotive Being Pulled Up Inclined Plane.

Notwithstanding its long fall the engine was not greatly damaged. The cab and small parts had been stripped from it, but the frame, boiler and wheels were intact, so that after it was retracked it was hauled to the shops on its own wheels, and was soon ready for service again.

The Ocean Carrier.

BY J. RUSSELL SMITH, PH.D.

XIII.

Charter Freight Rates and Attempts at Their Control.

The sea is free, and in a consideration of the principles controlling its freight rates the cast-off theories of land transportation are found to apply to its principal lines of trade. The most pronounced change in the theory of land transportation is the growing recognition of the fact that competition is not the controlling force that it was once supposed to be. Upon the ocean, on the other hand, the theory of free competition still finds application.

The reason for this difference between land and sea transportation will be most easily seen if one considers for a moment what constitutes the unit of transportation by land and by sea. Upon the ocean it is a single ship. Ports are open to all; the ocean is a free and toll-less highway upon which the ships of all nations may and do come and go at will. Upon land the railroad train renders the similar carrying service, but the carrying unit is the railroad itself complete from end to end. The equipment for carrying a ship's cargo 3,000 miles is not 10 per cent. more costly than that of carrying it across a narrow channel. The cost of equipment necessary for supporting a train may be roughly put at 50 to 100 per cent. of the value of the train for every mile it goes. Before a train can be run 3,000 miles there must have been years of labor for the building of 3,000 miles of railroad, requiring the investment of one to two hundred millions of dollars in roadway, terminals, branches, feeders, repair shops, etc. A new competitor for this same 3,000-mile service must expend another hundred or more millions prior to running the first train and, as population increases, the cost of railroad building increases because of higher land values. Equipment for sea carriage, on the contrary, becomes cheaper year by year through the process of invention. Ocean transportation investment requires the ownership of vehicles only—movable capital. Railroad transportation investment is chiefly in the form of fixed capital—roadway, structures and terminals. This heavy investment of fixed capital must earn dividends where it is placed or be an almost total loss. In contrast to this the steamship or sailing vessel capital is the most mobile in the world. The world ocean is open to it, and it can speed away to the shore of any and every maritime country upon the surface of this terrestrial globe.

A discussion of ocean freight rates must be introduced by a brief reference to the two distinct methods of operating ships and carrying on the transportation business: (1) Charter traffic, in which the unit of operation is a single vessel working independently; and (2) line traffic, in which many ships combine to render one service.

1. *Charter Traffic.*—The fact that the sea is an open highway enables any navigator to go where he will and engage singly in the carrying trade, if he wishes to do so. This absolute independence of the single ship has its economic advantages. No costs need be incurred except those necessary for the particular traffic in hand. If the shipper can deal in ship-load lots, he has no need of a liner. He hires a vessel of his own.

The primary object of tramp or charter traffic is cheapness with efficiency. The primary qualifications of line traffic are regularity and speed. These entail costs, and there must be higher freight rates to make line traffic profitable. There is room for both services. The exacting traffic in manufactures and passengers is increasing, and with it the demand for line traffic and corporate organization. Along with this is the growing traffic in cheap and bulky goods requiring the service of unorganized cheapness. The trade of the present comprises many million tons of cheap and bulky raw materials which must be transported in great quantities and at the lowest possible cost. These usually go in ship-load lots as charter traffic.

If steel rails, iron, locomotives or other heavy manufactures are moved in sufficient quantities, as is occasionally the case, they may become charter traffic, but the staple articles for this type of ocean work are grain, lumber, coal, ores, sugar, cotton, petroleum, nitrate of soda, jute, etc. This is absolutely a world trade. The chief market for wheat is Great Britain and the nearby parts of the continent, but this one commodity is shipped from the Atlantic ports of America from Galveston to Montreal, from San Francisco, Columbia river and Puget sound on the Pacific, from the Argentine Republic and India, from Russian ports on the Baltic and Black seas, from the Danube river and sometimes from Chile and Australia. Cryolite comes from Greenland; nitrate of soda from Chile; nickel ore from New Caledonia; iron ore from Arctic Norway, Sweden and tropic Cuba; jute from Calcutta; wool from New Zealand; sugar from Germany, Cuba, Java, Brazil and Peru. There is no ocean, no zone, no continent, no great island that does not contribute its threads to this world mesh of routes including hundreds of ports to and from which sail thousands of ships, each ship operated independently and usually as the result of a particular bargain between the shipper and the carrier. Here competition reigns.

A cargo is in the warehouse and a ship at the anchorage: what shall be the rate if the ship takes the cargo? Both parties are after profits. If there is a cheaper ship in sight, the shipper takes it. If there is a better cargo in sight, the ship takes it. If cargoes are plenty and ships are scarce, the rates will rise to the point where it is cheaper to let the goods lie rather than move them at the increased rate. A 300 per cent. rise in rates has occurred within a fortnight, although plenty of ships were lying idle in the next ocean; but they happened to be 50 days away and the goods had to go within a month. In this case, for that particular traffic the idle ships did not exist, although the next month they were on the spot and rates came down again to their former level. If ships are plentiful and cargo scarce, the ships bid for the cargo and rates go down and down. If profits cannot be made, the manager aims to cover expenses; if not whole expenses, then enough of the expenses to make a small loss rather than a great loss, and he ties his ship up only when his operating losses exceed the loss resulting from absolute idleness with its rapid depreciation and interest and other costs.

The charter rate is a marginal rate. If there are 10 ships and five cargoes, the cheapest ships get the cargo. If there are 10 cargoes and five ships, only the highest paying cargoes can be moved. Fluctuations are, therefore, sharp and there seems to be a present tendency for rate depressions to be prolonged. There are several reasons for this prolongation. One is the appeal that the shipping business makes to the gambling instinct. There are seasons of great profit; ships at times pay for themselves in a year. There are also years when there is only loss, because the great prizes have served as a magnet to draw too many people into the shipping business. Again, it requires no special knowledge. A person needs only some capital and the acquaintance of brokers who will buy him a ship and other brokers who will secure her cargo on commission. A novice with money could begin in an hour after he reached a long distance telephone anywhere in the United States or England.

It is customary in the business, especially in Great Britain, for an enterprising manager to form a stock company and build a few ships which the promoter manages on a salary or commission. The ship builder or the public will often loan money on these ships so that the company has a divided responsibility in stock and bonds much like an American railroad. The greater number of charter boats are apparently owned outright, but when depression strikes the business and there is any tendency toward maintenance of rates the manager of a mortgaged fleet is goaded to desperation by the knowledge that the holders of the bonds and probably of the stock also must have some satisfaction or his ships will be foreclosed and his company and his business wiped out. Thus the mortgaged ship is a rate depresser.

Another factor tending to prolong depression is the cheapness

of new ships. When the demand for new ships falls off, the ship builders face the necessity of turning off their men. To prevent this they will build ships at a very low figure and keep their force together for better times. These changes in the price of ships and in the prosperity of the shipping business quickly respond to the state of the carrying trade. In the prosperous year, 1900, the chairman of a British shipbuilding company in addressing his stockholders said: "A ship which four years ago could be built for £70,000 to-day would cost £100,000." In August, 1900, a freight steamer 11 years old brought at auction £30,000. In November, 1901, after a break in rates, the same steamer sold for less than £18,000.*

During periods of cheap ship building the manager of chartered vessels sees a good opportunity to provide himself with some thoroughly modern ships at a low figure and be ready for the hoped-for advance when it comes. If it does not come immediately, his new vessels, possessing all the latest economies and low capital cost, can be operated more favorably than older, less efficient and more costly vessels. The result of this reasoning and of the action which grows out of it is that the amount of building does not readily respond to depressions in rates, and these depressions drag on to great length because ship building continues in spite of them. The low rates which resulted from a number of causes in the spring of 1901 can scarcely be said to have had any relief till the autumn of 1905. Any signs of higher rates brought out idle ships from their moorings, and these ships promptly put the rates down to the dead level.

Why do not the owners of vessels for hire agree upon rates and maintain them? This problem is akin to that of universal peace among nations and really does involve the harmony of many nationalities. Will the Greek, the Turk, the Chinaman and the Hindoo agree with the men of Liverpool and London, New York, Hamburg, Marseilles, Genoa and Christiania, and will they all adhere to the agreement if they make it? What if the agreement leaves a man's ship idle while the other 98 per cent. of the tonnage is busy with profitable voyages at the agreed rate? By the slightest shade of undercutting he can be deluged with cargoes. Will he abide by loss that others may profit? Even if the ship owners of the world should agree, and keep their agreement, there are a thousand other men now in their employ who know the business. Capital awaits investment. Ship builders will build ships for any responsible party in a few months. Ships are always being sold so that you and I may buy some to-day, place them in the hands of a broker or agent whose business it is to find cargoes and manage ships, and behold, there is competition again upon the sea. The biting and absolutely controlling force of this competition lies in this: If 98 per cent. of the shipping should be operated under a maintained rate agreement that gave good profits and there arose any dearth of cargo, the 2 per cent. of independent ships with a rate a shade below the agreement rate would be desperately busy and profitably employed. All the idleness would be with the agreeing ships, the new building would be with the outsiders, the increase of idleness would be with the agreeing ships until their union perforce broke down because of the large number of idle ships in the union and the prosperity outside of it.

The line separating profit and loss seems to set the limit to which charter rates can possibly be raised by agreements among carriers. Above that point there is no need of agreements, since, if cargo is more abundant than ships, rates are high from natural causes and, if there is an excess of tonnage, the rate cannot be upheld for the reasons previously stated. This statement is borne out by the history of attempts at rate control and by the united opinion of ship owners themselves.

The lack of successful rate control by the owners of charter vessels cannot be charged to lack of experience in co-operation. There is a large number of shipowners' associations in all large shipowning countries, and especially in England, where the bulk of this class of shipping is owned. In London alone there at least nine such organizations. These associations exist for nearly all the purposes that can be attained by co-operative action. The annual report of one of the Liverpool associations for 1905, for example, describes efforts to effect favorable legislation in London; to change local harbor regulations; to persuade the government to take action on the policy of various foreign governments toward British shipping; to change charter party forms (form of chartering agreement); to change coal trimming charges at Cardiff; to reduce Suez Canal tolls, etc. One strong and growing association exists only to fight organized labor, and many associations are concerned chiefly with the ever present insurance question. They are often perfectly willing to spend £5,000 sterling in combating a case involving £100 and a precedent. One of these bodies—the North of England Protecting and Indemnity Association—reported that on December 31, 1905, there were enrolled in the association 2,470 steamers with a tonnage equal to about half of the total under the British flag. For some purposes at least the ship owners know how to co-operate.

The recent prolonged depression in freight rates which began in the spring of 1901 produced two serious attempts at charter rate control of an international character, and their results help to show the limitations upon such efforts and their essential futility as producers of profitable rates. The condition of the shipping business in this period was such as to drive men into agreements, if any economic force could produce that result. The shipping journals were full of letters, articles and editorials proclaiming the unprofitable conditions of the trade. The president of the Clyde Steamship Owners' Association declared in his annual address, January 20, 1903, that it was hardly possible to sketch out a round voyage on which a freighter could pay expenses. A British shipowner of much experience stated in March, 1905, that "on the average, British sailing ships of over 3,000 tons (dead weight) have lost about £1,000 each per annum during the last three years and that smaller vessels have fared almost as badly." On December 29, 1904, *Fairplay* summarized the report of 49 tramp vessel owning companies for the year then ending. They had 393 vessels of 1,184,358 gross tons, capital £10,253,752, and debt £3,157,128. Assuming 5 per cent. interest on the indebtedness and the customary 5 per cent. for depreciation, they would have required £140,040 more than their total earnings to avoid a loss even if no allowance be made for income tax and management expenses. A month previous to the publication of the digest of these reports, the same journal had declared editorially that, "taken upon the whole, tramp tonnage is being run at a disastrous loss." At the end of 1903 a similar analysis of 36 companies showed results like those cited above, and six of the 36 had actual cash loss for the year on operating expenses, to say nothing of expenses of management, interest on bonds, depreciation or dividends.

In such times as these anything tending to improve the condition of rates was eagerly snapped at. The French bounty-fed sailing ships, receiving a government bounty that paid almost enough to run them, were in a position to make competition exceptionally ruinous for British and German ships of the same class. There was an international conference of these sailing vessel owners in Paris in December, 1903. It drew up a constitution for the "Sailing-ship Owners' International Union," which was to become operative when subscribed to by the owners of 75 per cent. of the shipping involved. The organization, with headquarters in London, was formally launched in June, 1904, when the first rate committee announced the schedule of minimum rates for the guidance of its membership. The circular sent to the members in June, 1905, states that

> The Sailing-ship Owners' International Union . . . has only to do with vessels of 1,000 tons net register and upwards, and the control of the union is in the hands of an international committee, the members of which are appointed annually by the various nationalities in agreed-on proportions.
>
> Although it is obvious that much good work might be done in many directions by such an international association, the only object of the union for the present is the binding together of sailing-ship owners not to accept less than certain agreed-on rates for freight for the principal homeward voyages in which sailing-ships engage, and members of the union are bound under a penalty not to charter their vessels at a lower rate than the minimum prescribed by the committee of the union for any particular voyage.
>
> The intention of the union is not to push up freights to such an extent as to oppress shippers or check business, but to prevent the ruinous competition which has come into the business and reduced freights to such a point that they could not possibly pay expenses, and in many cases were leaving heavy losses to owners.
>
> The union was originally started on the basis of not less than 75 per cent. of the British, French and German tonnage interest being included, but for 1905 the percentage has arisen to 87 per cent.

By November, 1905, the seventh freight circular had been issued, but most of the rates had remained unchanged, except to permit a small reduction to cargoes of over 2,500 tons. In 1906 the organization was still in healthy existence. Its limitations become apparent when it is noted that it applies only to the longest voyages, namely, the Pacific coast of North and South America, Australia and New Caledonia to Europe, and that it covers only the return voyage, leaving absolute freedom for the outgoing voyage and for all other trades.

A shipowner who had been influential in promoting the union said of it in a letter in December, 1905:

> This Sailing-ship Union would never have come into existence if it had not been for the French sailing-ship bounties and the absurd manner in which these bounties are paid. If the French ships had been competing on level terms, there would have been no need of any union. So far as I know there has been no attempt on similar lines to control sailing vessel rates in the past, and I know of no combination among shipowners which has held together as this one has done. The minimum rates adopted are intended to prevent loss rather than make gain. In most cases they are lower than cost, taking into account the outward rates that have been ruling, and which, of course, come into the calculation for the round voyage. The idea of the union, however, has been, if possible, to steady the freights, interfering as little as possible with the ordinary course of business and the natural fluctuations of the market. At the present time, unfortunately, the only place from

*See *Lloyd's Weekly Gazette*, Oct. 5, 1905, p. 638, and *Fairplay*, Nov. 21, 1901.

which anything in excess of the minimum rate is obtainable is from Australia, the conditions of the markets on the Pacific coast both of North and South America being such that the minimum rate is barely obtainable. The minimum rate applies to vessels of 2,500 tons, and for every increase on this size a slight reduction is allowable, as it was found that the larger ships could not get employment as long as the smaller vessels were available on exactly the same terms.

As far as the members of the union are concerned, the minimum rates have been maintained wherever they have been fixed, say west coast North and South America and Australia. Unfortunately, owing to the want of cargo on the west coast of North America, and the accumulation of tonnage in South America, various union ships have been unable to get the minimum rate and have required to move in ballast to some other part of the world where prospects were better. The small percentage of ships still outside the union, moreover, has at various times caused trouble by cutting in just under the union rate. The prospects are, however, that for next year fewer ships will be outside the union.

An owner with a fleet of vessels in the union, states its advantages thus: "I think you might put it that they provide for a small loss rather than a great loss. This has undoubtedly been for the advantage of sailing-ship owners." The advantages of being among the few outside the union were shown by freight quotations at this time. The San Francisco *Chronicle*, January 28, 1906, stated that "apparently anything willing to take less than combination rates is promptly picked up." On February 18, the same journal stated: "Freight rates continue lifeless to the United Kingdom as well as from the north as from here. Charterers are not willing to pay combination rates, and it makes a deadlock for the present." That deadlock means ships lying idle in the harbor, eating up the owners' bank account. If that were being tried when a 2 per cent. cut on a *profitable* rate would give employment, it is not likely that the union would long survive.

The small scope and importance of this union as a force in the control of world rates appears from considering that it is limited (1) to minimum rates which are on a basis that affords no profit (e.g., wheat 22s. 6d. from San Francisco to Liverpool); (2) to certain long voyages; (3) to returning voyage only; (4) to vessels of certain size only; (5) to sailing vessels only, when sailing vessels all told are not now doing over 6 or 7 per cent. of the work of ocean transportation.

In January, 1907, this organization seemed to be on the verge of final dissolution. Strange to say, or rather, quite naturally, its embarrassment seems to have resulted from a burst of prosperity attendant upon the rebuilding of San Francisco after its destruction in April, 1906. There was a great demand for coal, cement and steel which doubled the out rate from Europe from 15 to 30 shillings per ton. Under the normal conditions of trade, the rate outward from Europe is a by-product rate, a ballast rate. The larger movement of freight is from the Pacific to the Atlantic, and the ships take back anything they can get at any rate they can get, or as alternatives take ballast. That is why sailing vessel-owners made no attempt to control the out rate.

The San Francisco disaster suddenly reversed things. So many ships went out with building material that there was a plethora of shipping seeking return cargo, and having had the unusual experience of making profit on the out freight, they were willing to take a by-product rate home again. This the Minimum Agreement prohibited. "This standard has been circumvented by vessels being fixed on a round freight from United Kingdom or continent or from New South Wales to west coast and home to United Kingdom or continent.*

One week after the above sentence was published in London, the Shipowners' Union sent out on January 11th a new rate circular to members saying that there would be no change in the minimums last announced except that the nitrate rate to the United Kingdom and continent would be suspended from January 14th. This was a very extensive exception, being quite half of all that the union stood for. Lloyd's Liverpool correspondent spoke of friction in the association, of its frequent meetings, of rumors of German withdrawal. "Indeed it is felt," he continues, "in some quarters that its breaking up is only a matter of a very short time. The abandonment of the nitrate rates was apparently the beginning of the end. This, however, proved to be a continuance of life rather than the death rattle, for the organization was still in a normal condition (minus nitrate rate) in February of 1908.

The same conditions of depression that drove the sailing vessel owners of Paris brought about a somewhat similar conference of steamship owners in Copenhagen in February, 1905. The success of the sailing vessel owners was one of the reasons that led to the assembling of those interested in the commerce of the Baltic and White seas. This narrow geographic unit has corresponding to it what might also be called a commodity unity also. The trade is predominantly in wood and lumber, with coal as return freight. The great world markets for oversea lumber are the United Kingdom, Germany, Holland, Belgium and France. This import trade amounts to more than 15,000,000 tons, and less than a fifth of it comes from across the Atlantic. The remainder, or more than 12,000,000 tons, is shipped from Norway, Sweden and Russia. This is one of the greatest items in the world's trade.*

This traffic, while international, is little greater in geographic extent than is the traffic of the American Great Lakes. Some of the leading shipowners, dissatisfied with unprofitable timber carrying, conferred for three days at Copenhagen in February, 1905, and fixed a minimum scale of rates for the various ports, and then went back to their various countries to work up support for the scheme so that it might be put in force at another conference in June. In this they were successful, but only as regards the outgoing rate on lumber. The total vessel tonnage affected by this agreement is only about 1,612,000 divided among 1,048 steamships. Although this Baltic and White Sea agreement is purely local in character it is the most comprehensive among charter steamship owners that has as yet been seriously considered. This organization has had no revolutionary earthquakes to upset its plans and is now entering upon its third year in better shape than the Sailing-vessel Owners' Union, which was its prototype. The Scandinavian winter makes the Baltic trade quite largely a summer season trade. In the season of 1906 the agreed-upon rates were maintained, and on April 12, 1907, there was another meeting at Copenhagen to arrange for the ensuing summer. Much exhortation was given the members to insure their doing nothing that would increase the difficulty of maintaining the rates.

This organization has busied itself much with work of the kind usually taken up by the various shipowners' associations of Great Britain, namely, the establishment of favorable and uniform charter parties. These blank forms or contracts are exceedingly important in such an organization, for by them it would be easy to name a uniform cash consideration and bring about practical discrimination by varying the clauses about measurement, loading, discharge, or insurance of cargo, etc.

These two rate agreements, the small and weakly newborn offsprings of the most profound shipping depression of modern times, seem but to emphasize the controlling force of free competition in deciding the charter rate, which is a world rate. If the agreeing Baltic carriers should push their rate much above the general level, they would probably be greatly embarrassed, and the timber shippers greatly pleased, by the appearance of ships sent in by the hungry and enterprising Greeks, Hindoos and other shipowners from the remotest ends of the earth.

(To be continued).

*Lloyd's Gazette Weekly, 1907, p. 10 and p. 41.

*American wheat exports amount to from four to seven million tons per year, and sugar (about 2,000,000 tons) is our heaviest import.

Foreign Railroad Notes.

The French in their several colonies in West Africa in the five years since 1902 have built 554 miles of railroad, in addition to the 370 miles then open. Capital has been provided for building 466 miles more. The longest of these roads extends from the River Sevegal at Kayes, the head of navigation, which is 320 miles from the mouth, southeastward 345 miles to a navigable part of the Niger at Koulikoro, 420 miles up stream from Timbuctoo, of which the poet says:

If I were a cassowary,
On the plains of Tim-buc-too,
I would eat a missionary,
Skin and bones and hymn-book too.

The course of the Niger from Koulikoro to Timbuctoo is north-eastward, thence southeast and south more than a thousand miles to the Gulf of Guinea.

The gentlemen who drive their cattle on the tracks in front of trains to recover damages must hide their diminished heads before a Belgian peasant. He had been slightly hurt by a railroad accident and had been paid $75 therefor. Delighted to find that his skin might be a source of income, he loosened a rail on the track about a quarter of a mile from a station, took the first train from that station, and succeeded in being hurt when the train ran off and killed the engineman, wounding five men seriously and others slightly. He insisted on going home, and for some reason was suspected. When a policeman came to search his house he took a gun, ran into the field and shot himself.

The Central Northern Railroad of Argentina was opened on the last day of 1907 from Jujuy northward 176 miles to the southern border of Bolivia at La Quiaca. The new road was built by L. Stremitz & Co. for $6,894,659 gold. Jujuy is 2,133 ft. above the sea; La Quiaca, 11,293 ft. The highest point on the line, however, is 62 miles further south at Tres Cruces, 12,100 ft. above the sea. On the southern 21 miles there are 125 bridges from 7 to 690 ft. long. For six miles Abt cog-wheel engines are used. A section of the line is liable to be covered by mud and rocks brought down by torrents from the mountains. La Quiaca is about 150 miles south of Potosi.

The Metal Tie.*

BY DR. ING. A. HAARMANN,
Geheimer Kommerzienrath.

III.

An efficient means of attaching the rail to the tie has always been of material importance in extending the use of metal superstructure. The main considerations in this connection are: Avoiding the bending of ties to secure inclination of rail; efficiently protecting the tie against wear; reducing the number of pieces needed for attaching the rail; increasing the ease of track-supervision, and providing for easy gage adjustments on curves. These considerations led to the introduction of my hook plate fastening on the Prussian State Railroads as early as 1882. The hook plate gives the rail its inclination and distributes the pressure on the tie. By entering into the tie, and by grasping the flange on the outside, it renders additional fastenings at this point unnecessary, and as a result of the uniform spacing of the holes in the ties it makes adjustment of the gage on curves a simple matter.

To be sure, the first hook plate was not perfect, especially was it too small (Fig. 34). But the tie of that date had defects also, prominent among which was too narrow an upper surface. Too much account was made of actual requirements, and too little of the much greater demands of the future that were but dimly appreciated. For the somewhat wider ties of sections 51 and 52 (Fig. 33, *Railroad Gazette*, March 27), the plates could be made longer, but even this size was not sufficient, as was evidenced by the wear of the ties and of the plates. By increasing the width of the plate, and in addition transferring the seat for the clip to the hook plate itself, the hook plate fastening was materially improved. The movements of the rail were, however, still communicated to the hook plate, so that the surface wear of the ties and fractures at the corners still continued. To remedy this, an inside stud was added, and this so-called "stud plate" was in addition provided with a rib having an inclined face for the clip to brace against, thus getting a firmer grasp on the rail. While this arrangement permitted the adjustment of the gage by the use of a single size of clip instead of the four sizes heretofore required, the added stud required that holes be made in the tie differently from the standard. Another arrangement, not open to this objection, was that in which there was only one stud, this being on the outer side of the stud plate, the stud filling the hole but not being provided with a hook. These stud plates represent the transition from the older hook plate to the newer hook stud plate, which, combining the advantages of both, neither requires a perforation of the tie different from the standard, nor lacks the increased safety furnished by the hook. It excels both in the increased surface of contact and in that it provides a cover for the hole receiving the stud, thereby insuring longer life to the tie.

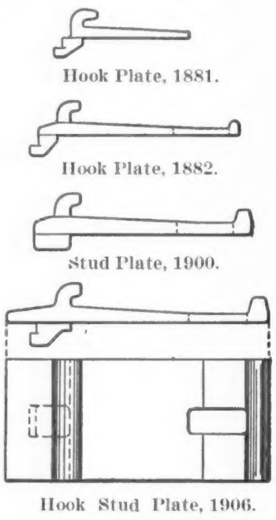


Fig. 34—Development of the Hook Plate.

Fig. 35 represents graphically the yearly increase in the number of hook plates. The lower line gives the quantities furnished yearly, the upper line the total number that have gone into service, amounting to 57,000,000, or enough to equip 12,400 miles of track. As regards the hook stud plates, after a preliminary trial in the spring of 1906 on the Württemberg State Railroad (Fig. 36), 25 miles of track have been equipped with them by the Oldenburg State Railroad (Fig. 37). In Württemberg and in Oldenburg the rib ties proposed by me have been adopted. They were first laid on the road between Georgsmarienhütte and Hasbergen; then, since 1900, on a section between Cologne and Hamburg, and, since 1904, on several sections of the Breslau and of the Elberfeld divisions of the Prussian State Railroads. The chief feature of the rib tie consists in two ribs along the upper edge that secure the bearing plates in their position. They have curved sides, a broad base and are easily tamped. The Württemberg specifications require a spacing of 28 in.; the Oldenburg, 28⅛ in. The bearing surface of the track is about the same in both cases and exceeds that of the American roads with their well-known close spacing of wooden ties. The Prussian State Railroads have decided to adopt the rib tie with hook plate fastening as a standard. The tie will be the same as before, with the addition of the ribs; the width is 9⅛ in., bearing surface 971 sq. in. and weight 137 lbs. (Fig. 38). At the joints the so-called broad-tie, form 66, is to be used. This tie, with two pairs of ribs, has a bearing surface of 2,016 sq. in., and weighs 282 lbs. The hook stud plates are adapted to a 3¾ in. flange (Fig. 39). The illustration (Fig. 40) shows the track of the Georgsmarienhütte Railroad; 300 miles of road will be thus equipped by the State Railroad management. It is perhaps worthy of notice that malicious tampering with this style of track is much more difficult than is the case with one using wooden ties and spikes or chairs and wedges. Whoever has seen a rib tie crack in operation will never be satisfied with one with wooden cross ties.

In 1880 the late Privy Councilor Grüttefien read a paper at

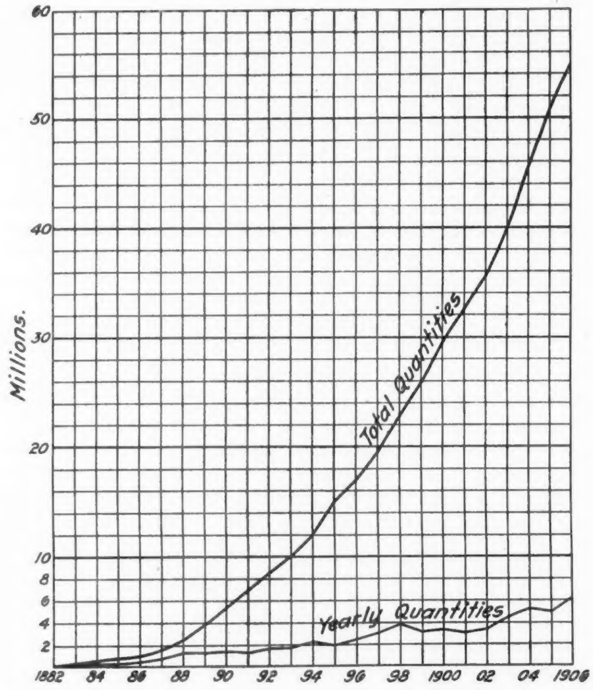


Fig. 35—Total and Yearly Quantities of Hook Plates Used for Permanent Way with Metal Ties.

the meeting of the Iron and Steel Institute at Düsseldorf "On the Results Obtained with Various Systems of Permanent Way in Prussia." At that time it was impossible to foretell that the metal cross tie would be the victor in the contest with the longitudinal tie. It therefore seems irrational to cite against the metal tie, as does the society for furthering the use of wooden ties, the deductions made by Grüttefien 27 years ago, when the development of the metal tie was only beginning. This authority pointed out that the Vautherin tie and the Hilf tie were too weak, too short and too light. But he also said, and this was based on the experience of the Prussian State Railroads with metal ties for only five years, that the eventual success was not doubtful. This opinion he based on the better lasting qualities of the metal ties, the more reliable methods of attaching the rails, the greater uniformity in spacing, the diminished tendency to creep and the quiet and elastic movement of the rolling stock. Citing England and the United States is not to the point, if for no other reason than because the conditions obtaining in those countries are quite different from ours. In England unusually large masses of metal mounted on broad wooden ties are used, and in the United States they are not niggardly in the matter of wooden supports. But that thereby the riding on English or American tracks is more satisfactory than on our own, I deny from personal experience. Even on the well cared for Midland Railway almost every joint is felt, and the jars and oscillations on the line from London to Liverpool, and on that from Liverpool to Manchester, in spite of the careful maintenance of track and the inspection of wedges morning and night, leave nothing to be desired on the score of distinctness. Rather might the riding over some of the American roads be considered superior.

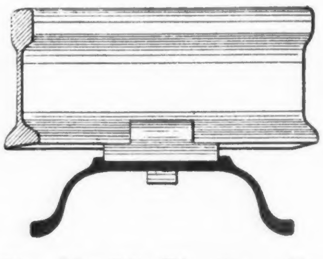


Fig. 36—Rib Tie, Form II; Württemberg State Railroads.

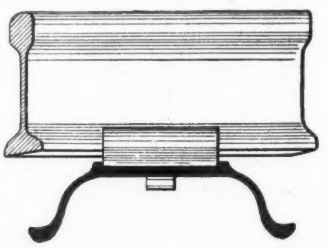


Fig. 37—Rib Tie, Form III; Oldenburg State Railroads.

*Address delivered at the meeting of the "Verein der deutschen Eisenhüttenleute," Dec. 8, 1907, at Düsseldorf. Reprinted from *Stahl und Eisen*, by permission.

But that is not entirely the result of the close spacing and of the heavier rails, for a material part is due to the many wheeled American trucks, which are excellently equipped with springs and which in combination with the long cars adapt themselves to the track with the utmost ease. On a previous occasion I have called attention to the importance of the truck and I can now only confirm the statement that in regard to it the American roads have the lead. This statement is not incompatible with a weakening of my former enthusiasm for the Pullman cars, that vary considerably in the quality of their accommodation. As to the tracks themselves? There are some main routes, for instance those of the Pennsylvania Railroad, that are treated like parade horses and are cared for and caparisoned accordingly. But there are also other less favored lines owned by the same company, e.g., Buffalo to Harrisburg, that are treated more like cart horses. Opinions concerning English and American railroads must be accepted with some caution. The layman is apt to mix cause and effect. In the United States the opinion is more exalted as having to do with a "great country." One of its railroad magnates, Mr. Gould, a few weeks ago expressed him-

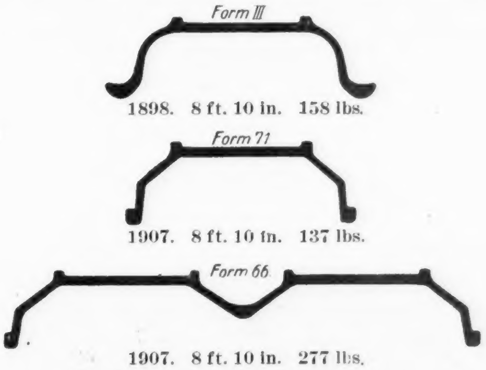


Fig. 38—Rib Tie Sections.

self to the effect that, "Between our railroads and those of Europe there is no comparison. Ours are the best in the world." He did concede that he had seen some pretty fair ones in Germany. In this qualified praise he was about right, for here just as yonder there is a difference between the permanent way and car equipment of main lines and those of branch lines. Perhaps there is another difference; possibly the citizen in Germany protests more loudly if he considers himself unduly neglected in governmental regulations than does the citizen on the other side of the pond. But in making his critical remarks, Mr. Gould should not have forgotten

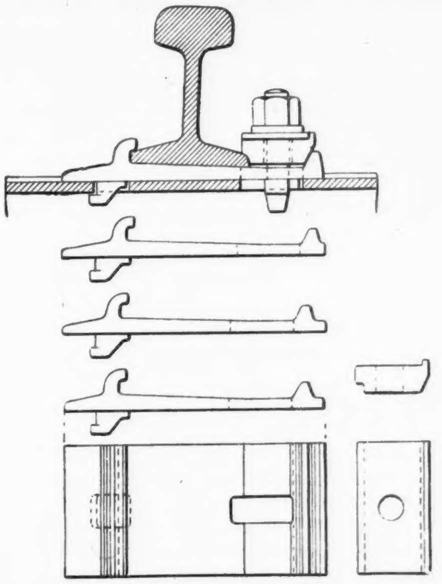


Fig. 39—Hook Stud Plate; Prussian State Railroads, 1907.

that while accidents cannot be avoided entirely, still those recorded in America go far beyond a reasonable average.

Those who defend the wooden tie from principle cannot be reproached with the fact that the perfecting of this tie has not kept pace with the development of the metal tie, because that was a matter beyond their control. Should it be necessary to give this member particular dimensions, a desirable shape or a definite weight, such requirements entail no problems with the metal tie. A case in point is the broad tie for joints, made to meet the requirements of the administration of the Prussian State Railroads. If the demand were made for ties of still greater weight, no rolling mill would declare it impossible. And if specifications called for a tie to have a life of 50 years or more for use on lines with heavy traffic, even this demand the iron and steel industry would meet, furnishing a product of great uniformity both as to shape and quality. In making these assertions I am exaggerating in no way. The old and light Cosyns ties, which, after having stood 40 years' service, can still be used, although laid on a roadbed that cannot be compared with that of the coal regions, have demonstrated the lasting qualities of the material even with unfavorable ballast, and that is the important thing. Surely it is reasonable to expect that a metal tie properly constructed, proportioned and equipped, turned out in accordance with our present experience, will have a still longer life. The comparative behavior, under similar conditions of heavy traffic, of impregnated wooden ties and of metal ties with and without ribs is well shown by samples in the Osnaburg Track Museum. In view of the superior qualities of the metal tie, we iron and steel men are amply justified in placing it prominently in the foreground.

There is no question that the wooden ties have done great service; to deny their importance would be foolish. But is not the producer of wooden ties entirely dependent on the growth of the tree? In regard to dimensions, cross-section and length, resistance and durability, the friends of the wooden tie must be satisfied with the qualities offered by nature in each individual case. As it is impossible to make all the ties of a large order from trees of the same character in respect to age, growth and freedom from knots, we cannot speak of the uniform durability of the wooden in the same sense that we speak of it in the metal tie. The time for the selection of woods is long past, and the best that can be done is to delay its rapid deterioration by impregnation, and so defend it against the attacks of its numerous enemies. If the wooden tie is to reach a higher value for use, the means must be borrowed from the iron and steel industry, and, by equipping it with heavy tie plates or massive chairs, lengthen its life and increase its ability to render service.

In the estimate made to establish the relative economic value

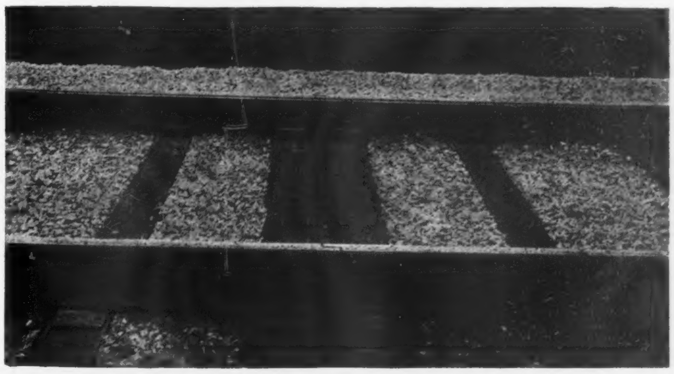


Fig. 40—Permanent Way with Rib Ties, Showing Joint Tie.

of the wooden tie and the metal tie, I have not taken into account as factors the undoubted increase in safety of operation, nor the favorable effect of properly constructed metal permanent way on rolling stock. Furthermore, I have left out of the reckoning the fact that the manufacture of metal ties means a considerable outlay in wages which would inure to the benefit of our country, and would amount to not less than $9.80 per ton.

The basis for the comparison are the specifications laid down by the Prussian State Railroads for the construction of permanent way for fast train service, i.e.:

1. A permanent way with 25 impregnated fir ties supporting a rail of 49 ft. 2½ in. long.

2. A permanent way with rib ties (forms 71 and 66, Fig. 38); 23 intermediate ties and one broad tie for the joint, this last counting for two single ties,* the length of rail being the same.

The cost of rails, splice bars, ballast and maintenance has been assumed to be the same for both systems, although we have sufficient evidence that metal ties, in the long run, require less labor for maintenance than do wooden ties. All prices for metal are official. For old material, I assume a loss in weight of 20 per cent. and a value of only $10.09 per ton. An estimate presented by me at a meeting of the "Verein für Eisenhüttenkunde," and which has not been controverted, sets forth that every ton of metal ready for use in permanent way represents an income from freight to the railroads transporting the finished or partly finished products, the scrap and the raw materials (coal, coke, pig iron, slag, etc.), amounting to $6.54 and, including the old material, to $7.20. This item cannot be disregarded even though the freight charges do not in every case inure entirely to the benefit of the road purchasing and using the ties. All that interests us is to obtain average values applicable to the large territory served by the Prussian State Railroads. The fact that other roads, on account of their geographic

*Since this paper was read, new specifications for the standards of permanent way require 24 intermediate ties and one joint broad tie, *i. e.*, one tie more than above.

or economic position, may have to use different values does not change the general accuracy of the proposition. As the wooden ties have also to be transported, I will deduct the freight on the finished metal ties and instead of $6.54 or $7.20, place the freight receipts at $5.45 per ton, thus avoiding any charge of discrimination in favor of the metal tie.

The cost of the impregnated tie is not obtainable from official statistics, as these give only the average cost of the total of wooden ties, making no distinction as to their character, whether impregnated, fir, beech or oak. I shall have to rely, therefore, on my own general knowledge. It would certainly not be excessive if I assumed the cost of the ties ready for laying in the track (including cost of impregnation and planing, but excluding transportation from storage points to place of use) at $1.20 each. Incidentally, oak ties on the same basis cost $1.62 and beech ties $1.80. But I will assume the purchase price of the impregnated fir tie at only $1.02. It is assumed that the ties remain in use in main track up to the time of their removal, and the value of these old ties I will put at the rather high figure of 30 cents each. This is on the assumption that they will be fit to some extent for use on sidings, although many, probably the most, will be disposed of for fuel at much lower figures.

Next the question of their life. Experience has shown the average length of service for impregnated fir ties on main tracks under heavy traffic to be 10 to 12 years. I will assume 12 years. After what has preceded we might reasonably allow to the rib tie three times as long a life. I will not go so far, however, and will content myself with 20 years as the average length of service for metal rib ties.

In regard to the fastenings, it is known that their renewal generally coincides with the removal of the ties, excepting possibly in the case of the bolts, which often require earlier replacement. Eight years' experience with rib ties furnish the assurance that the carefully designed hook stud plates and the clips, with their large contact surface, will have a length of life equal to that of the tie. This result can be confidently expected, as the hook stud plates are now being worked out of the cold bar by especially designed machines. For the T-bolts I assume an average life of 12 years. As the hook plates of the wooden ties are of generous dimensions, I assume that they will last 18 years, while the small clips and the tie screws will be worn out in main track service in from 10 to 12 years, the same as the ties. Possibly this may be too optimistic for these last, as the repeated tightening and refastening occasion considerable wear. Finally, the cost of the labor of replacements, taking out old ties and putting in new ones, must not be neglected, and for this, whether the ties be of wood or of metal, I will allow 12 cents per tie.

Based on the above data, the following is the calculation in detail of the net cost per mile of the ties with their attachments required by the two systems, credits being allowed for the value of scrap and for the freight earnings accruing from the transportation of material as noted above.

1. *Fir Tie Permanent Way.*

25 ties supporting rails 49 ft. 2½ in. long.

No.			
2,685	Fir ties, each ($1.02 — 0.30) at $0.72	$1,933	
	Labor replacing ties, 12 cents each	322	$2,255
4,939	Hook plates,* 14.6 lbs. each = 36.055 tons		
430	Hook plates,† 14.9 lbs. each = 3.204 tons		
	39.259 tons at $39.27 — 5.45 = $33.82	$1,326	
	Less scrap 31.407 " at 10.90	343	983
5,797	Clips, 1.28 lbs. ea. 3,710 tons at $54.45 — 5.45 = $49.09	$183	
	Less scrap 2.968 " at 10.90	32	151
16,522	Tie screws, 1.03 ea 8.459 tons at $56.72 — 5.45 = $51.27	$434	
	Less scrap 6.820 " at 10.90	74	360
			$3,749

*For intermediate ties.
†For joint ties.

2. *Rib Tie Permanent Way.*

23 intermediate and 1 joint broad tie (counting for 2 ties) supporting rails 49 ft. 2½ in. long.

No.			
2,467	Intermediate ties, 137.3 lbs. ea. = 169.355 tons		
108	Joint broad tied, 277.0 lbs. ea. = 14.958 tons		
	184.313 tons at $24.43 — 5.45 = $18.98	$3,498	
	Labor replacing ties, 12 cents each	321	
		$3,819	
	Less scrap 147.45 tons at $10.90	1,607	$2,212
5,369	Hook stud plates 6.9 lbs. each = 18.523 tons at $54.54 — 5.45 = $49.09	$909	
	Less scrap .. = 14.818 " at 10.90	162	747
5,369	Clips, 3 lbs. ea = 8.052 tons at $42.54 — 5.45 = $37.09	$299	
	Less scrap .. = 6.443 " at 10.90	70	229
5,369	T-bolts, 1.5 lbs. each = 4.027 tons at $63.27 — 5.45 = $57.80	$233	
	Less scrap .. = 3.222 " at 10.90	35	198
			$3,386

The annual amount required to be paid into a sinking fund to cover, by the time replacements are necessary, the above outlays at the rate of 4 per cent. compound interest, is:

1. *For Permanent Way with Wooden Ties.*

Wooden ties, clips and screws for ties

$$\frac{(2{,}255 + 151 + 360)\ 0.04}{1.04^{12} - 1} = \$184.44$$

Hook plates for wooden ties

$$\frac{983 \times 0.04}{1.04^{18} - 1} = 38.54$$

$$\$222.98$$

2. *For Permanent Way with Rib Ties.*

Rib ties, hook stud plates and clips,

$$\frac{(2{,}212 + 747 + 229)\ 0.04}{1.04^{20} - 1} = \$107.07$$

$$\frac{198 \times 0.04}{1.04^{12} - 1} = 13.18$$

$$\$120.25$$

From the above it appears that in a country with an efficient iron and steel industry, wooden ties are at least 85 per cent. more costly than metal ties. If the difference of $102.73 between the annual payments to the sinking fund is to disappear, wooden ties must become materially cheaper. But these figures do not tell the whole story of the economic superiority of the metal tie. In addition to a

Fig. 41—Permanent Way with Rib Ties.

greater safety in operating, and a saving in wages, there would accrue to the country at large the indirect benefits arising from the regular and steady work that would fall to the share of the metal industry.

I am confident that the time is approaching when, in view of the demonstrated longer life and greater reliability of permanent way with metal ties, even after a very material reduction from present prices, the wooden tie will be regarded as too expensive. We must accustom ourselves to the idea that, as in ship building, house building, bridge building and in other fields, so also in railroad building metal is crowding out wood. When half of the 70 million wooden ties at present lying on 33,000 miles of important lines of main track are replaced by metal ties (which in itself would mean lower costs of operation and of maintenance) the saving in the amount of the yearly contributions to the sinking fund would amount to nearly $1,700,000, representing the interest on a capital of $42,500,000, and we iron and steel men would be in position to pay for labor additional wages amounting to over $26,000,000 yearly.

In this presentation and in the deductions made, I have only, as I believe, set forth clearly incontrovertible facts. If the German iron and steel makers share this belief, it will be their task to champion the metal tie energetically. The choice of the particular metal tie best adapted to given conditions will lie with the proper railroad authorities. I have the utmost confidence that these, both in the engineering department and in that of finance, will recognize the validity of my demonstration. Eventually, in our permanent way, the use of wooden ties will only be justified to the extent that in the interest of domestic forestry it may be tolerated on some branch roads. On the main lines they will have to be given up, and we can confidently hope that before long the entire structural part of the permanent way will be of steel and iron.

The distilleries of the upper Congo are protected against the pauper distilleries of Europe by a freight rate on spirits over the Congo Railroad at the rate of 70 cents per ton per mile, making $175 per ton, or $8.75 per 100 lbs., for the 250 miles.

GENERAL NEWS SECTION

NOTES.

The New York Assembly has passed a bill compelling railroads to issue half fare tickets to school children.

According to recent advices the outlook for a big wheat crop this year in the Kansas wheat belt is extremely good.

The Missouri Pacific has asked for a injunction forbidding the Nebraska Railroad Commission from attempting to regulate its traffic or rates.

It is understood that the Atchison, Topeka & Santa Fe has bought 1,200 acres of oil lands in the Midway field in California at a cost of about $2,000,000.

The Indiana Railroad Commission issued an order March 30 reducing express rates between 10 and 12 per cent. The Commission thinks the companies are earning too much.

At a conference between presidents of Missouri and Illinois roads and their general counsel, March 26, it was decided to test the constitutionality of the 2-cent passenger rate laws in those states.

On and after April 1 the Southern Railway will apply the 2½-cent passenger rate on all tickets sold in Tennessee. It will also give an open party rate of 2 cents for parties of 10 or more traveling on one ticket.

The Canadian Pacific has adopted a demerit system of discipline instead of the suspension system. Sixty demerits will be grounds for dismissal. For every year free from demerits, 20 demerits will be deducted.

On April 1, Attorney-General Bonaparte transmitted to United States attorneys information of 28 instances where the Federal Safety Appliance Law is alleged to have been violated. Of the total number, 13 occurred in California.

The Interstate Commerce Commission has reversed its own ruling and will allow transcontinental roads to grant rates to California for April 4 and 5, the occasion of manoeuvers by Admiral Evans' fleet, without insisting on the 30-day provision.

It is understood that the government will bring a test case as soon as possible after May 1 to try out the commodity clause of the Rate Law, and will thereafter not prosecute railroads for failure to comply with this clause, pending a decision of the Supreme Court.

The passenger department of the Southern Pacific announces that between March 1 and March 18 more than 7,000 people entered the state of California, most of the immigrants going to the northern part of the state. The company's tourist travel was 20 per cent. less this winter than a year ago.

The Oklahoma Corporation Commission on March 26 rescinded its former order ousting the Fort Smith & Western Railroad from the state on account of its refusal to do passenger business on a 2-cent basis. The Commission decided after a hearing that the road should be allowed to continue to do business on a 3-cent basis.

Chairman Knapp, of the Interstate Commerce Commission, wrote the Senate committee on interstate commerce March 30, to the effect that the Commission believed that a physical valuation of the railroads of the country could be completed in three years and that the total expense would perhaps be not less than $3,000,000.

Judge Pollock, in the United States Circuit Court at Topeka, Kan., on March 27, enjoined the State Board of Railroad Commissioners and the Attorney-General from putting into effect a new schedule of freight rates on April 1. The railroads alleged that the proposed schedule was confiscatory. The case will be argued on April 14.

Arrangements were made March 30 for the purchase by the city of Winnipeg, Man., of the entire holdings of the Winnipeg Electric Railway, which is a consolidation of the Winnipeg Electric Street Railway and the Winnipeg General Power Co., and operates the entire street railway, gas and electric business of Winnipeg and St. Boniface.

An appeal was made to the employees of the Chicago, Milwaukee & St. Paul last fall to economize in each detail of operating expense in order to avoid the necessity of reducing wages. According to recent advices, $160,000 was saved in January by careful work, about one-fourth of which is attributed to the saving in coal, due to careful locomotive firing.

For 589 railroad stations in the western New York car service district 65,569 cars were reported during February, as against 78,377 cars during the same month last year, a decrease of 29 per cent. The average detention was unchanged. For the eight months ended with February the Pacific northwest car service district reports 574,708 cars; a gain of 19 per cent. for the current commercial year.

A delegation of freight trainmen employed by the Philadelphia & Reading have asked the State Railroad Commission to obtain information for them about the working of the federal 16-hour law. They argue that the 16-hour limit often expires when they are only a few miles from a terminal point, and want to know whether it is their duty to stop work and tie up traffic under such circumstances, or to take the train to the end of the run.

Judge Thomas G. Jones, of the United States District Court, at Birmingham, Ala., made permanent on March 28 the preliminary injunction issued last August directed against certain acts in the Alabama railroad law which sought to prevent the railroads from going to the federal courts for relief. All rate acts are also suspended by the injunction until the justice of the rates can be determined. The opinion followed the general lines of that given by Justice Peckham in the Minnesota and North Carolina cases.

The United States Supreme Court has decided in favor of the company what is known as the Meat Rate case of the Interstate Commerce Commission v. the Chicago Great Western, involving the right of the company to reduce the rate on live stock products without making a similar reduction in the rate on live stock. The Commission found that the change of the rate on one article without a corresponding change on the other was unlawful, but the court reversed this decision.

Judge Calhoun of the United States District Court at Austin, Tex., on March 28 rendered a decision ousting the Western Union Telegraph Co. from Texas and assessing against it back franchise tax fees amounting to $100,000. The question at issue was whether the company had a right to transact a telegraph business between Texas points without first having obtained a domestic charter or a foreign permit to do business in the state. The company is now prohibited from doing any interstate business in Texas, except that for the federal government.

The Ohio Railroad Commission has added another rule governing the loading and unloading of cars and free time. It provides that when a consignee shall elect to work on a fixed standard of receipts his business shall be rated as to daily capacity and thereafter if the cars consigned to him exceed the rating, he shall be charged each day with 1½ times his rated daily capacity, 48 hours being allowed for unloading each day's placing, actual and constructive. The ratings shall be done by the railroad and the consignee shall have the right of appeal to the Commission. All ratings shall be filed with the Commission.

Assistant Postmaster-General McCleary has given his decisions on the questions of fining railroads for delays in handling the mails and of compensation for the so-called "half car line" mail routes, where a car is only needed one way, and the government has hitherto adopted the practice of paying only half the usual compensation for the round trip. Mr. McCleary has decided that the long roads of the West and South shall be divided into divisions of from 200 to 400 miles, and the penalties for failure to observe the schedule shall be exacted on these shorter hauls rather than on the long, continuous route. As regards the "half car lines," the railroads are to be paid for hauling mail cars both ways whether the cars are in actual use both ways or not.

The Eureka Tape Repairer.

A convenient steel tape repairer is being put out by the Chicago Steel Tape Co., 6233 Cottage Grove avenue, Chicago. It is made of thin sheet metal, folded in the shape of a sleeve and coated inside with a combination solder and flux. The heat of a match is enough for soldering the sleeve to the broken ends, making a strong joint. The sleeves are made to fit any width and weight of tape and are very light, a dozen of them weighing less than half an ounce.

Traffic Club of New York.

At a meeting of the Traffic Club of New York on March 31 an address was delivered by Capt. J. W. Miller, Vice-President and General Manager of the New England Navigation Co., who after recalling incidents of his earlier experiences in the Navy, read a paper covering the general subject of Water Transportation. Mr. Miller showed how in the last 30 years the opportunities of the West had turned away the American people from maritime enterprise, and predicted that the time has now come when the trend would be the other way and the merchant marine of the United States would be built up. He showed how in the course of development of the West

by railroads, rebates and other discriminations had arisen, and pointed out that a new era in transportation is just beginning, in which fair methods must be used and tariffs must be made more simple and understandable.

New England Navigation Company's New York Terminals.

The New York terminals of the New Haven Line and the Bridgeport Line were moved on April 1 to Pier 28, East River, near Catherine street. The steamers of these lines formerly used Piers 19 and 20, East river.

New York City Street Railway Conditions.

Mr. Ivins shows, taking his facts from the petitions of the receivers to the Federal courts and to the State Board of Tax Commissioners, that in 1894 the whole number of revenue passengers carried in Manhattan was 236,012,000, of which 5,306,000 were transfer passengers. In 1902 the total number of passengers had risen to 382,268,000, and the transfer passengers to 134,963,000. In that year gross receipts from operation were $19,739,000. Five years later, for the year ending June 30, 1907, the number of revenue passengers had fallen to 376,629,000, and the number of transfer passengers (transfers required by law) had risen to 194,765,000. The gross receipts at the end of this five-year period had decreased $377,737, and operating cost had risen $1,234,000.

Anybody can see that this is the road to ruin. Yet the responsible men of the Metropolitan system were led to believe, and the people were led to believe, that the universal transfer was a public benefit justifying consolidation of the lines and a liberal policy toward them. The result shows that a corporation can be asked to give too much.

The relation of the special franchise tax to the difficult, and, as it has seemed, insoluble problem of the street railway situation, is made no less clear by Mr. Ivins' calculation of the operating account of the system based upon the receivers' figures. From gross income from all sources of $21,919,692, there are to be deducted operating expenses of $13,172,571, leaving a surplus for maintenance, wage increase, renewal, depreciation, taxes, interest and dividends of $8,747,121. After the deductions for maintenance, depreciation, wage increase, and taxes, exclusive of a special franchise tax, are made, there remains available for interest and dividends the sum of $3,605,743. On the carefully estimated cost of reproducing the system, which Mr. Ivins puts at $106,500,000, this gives only 3.4 per cent. return. There could, of course, be no possibility of any dividends on stock, and the city would lose the $900,000 of special franchise taxes for which no provision could be made.

Mr. Ivins dryly remarks that in these figures "the invitation to private capital is not irresistible." A private corporation would not, the city should not, undertake to carry on a street railway business in New York under conditions and requirements that make this showing inevitable. The private corporation that has hitherto operated the lines has paid rentals and dividends only by starving the maintenance account until the roads are physically as well as financially bankrupt. The franchise tax they have not paid at all. The city has no right to undertake a losing business. The carrying of street railway passengers is not a philanthropy.

The teaching of Mr. Ivins' analysis is precisely the teaching of our present deadlock in subway construction. The lesson the people must learn, though they will be most unwilling to learn it, is the lesson that they and their lawmakers, in seeking to make better terms for the public, have made unbearable and bankrupting terms for the corporations. The stock watering and misdeeds of Metropolitan management are not involved in the problem. Mr. Ivins takes no account of the $240,000,000 of outstanding capital—his estimate is based on production cost. Against the abolition of the general transfer there would be a loud public protest. Against the repeal of the special franchise tax the voices of its original sponsors and of thousands of agitators who have since that time become vocal would be raised. But if transfers are to be given under present conditions, and if the other requirements of the law as it now stands are to be enforced, either surface railway passengers must be carried by the city on a charity basis or they will not be carried at all.

Mr. Ivins deserves the thanks of the community for the opportunity he has given it to look the facts in the face. We regard his utterance as deeply significant, a notable indication of the turning of the tide.—*New York Times.*

Some New Scherzer Bridges.

The New York, New Haven & Hartford, on which several Scherzer rolling lift bridges are in service, is building a number of additional bridges of this type. These include a double-track bridge across the Seekonk river at Providence, R. I., and six-track bridges across the Bronx and Eastchester bay on the Harlem river branch of the New York division. The New York Central is building a double-track Scherzer bridge across Wappinger creek on the Eastern division, which will be ready for service in the near future. Double-track Scherzer bridges for the Lake Shore & Michigan Southern and Chicago, Lake Shore & Eastern railroads across East Chicago canal at Indiana Harbor, Ind., are building, and will be ready for service when the canal is opened. The Norfolk & Western has two double-track Scherzer bridges building across the Southern and Eastern branches of the Elizabeth river near Norfolk, Va., and a single-track bridge is being built for the Seaboard Air Line across Hillsboro bay, Tampa, Fla., as a part of the terminal improvements being made by the Seaboard at that point. Two single-track bridges of the Scherzer type are being built for the Norfolk & Southern across Albemarle sound as the movable spans in a long trestle being built to replace the present ferry service between Edonton and Mackay's Ferry. The double-track Scherzer bridge crossing Coney Island creek for the Brooklyn Rapid Transit system has been in service for several months, carrying the heavy traffic on that line. The single-track Scherzer bridge crossing Rainy river for the Duluth, Rainy Lake & Winnipeg and Canadian Northern railroads is expected to be ready within 30 days. Work is also being pushed on the long span double-track bridge for the San Pedro, Los Angeles & Salt Lake across the San Gabriel river at Long Beach, Cal.

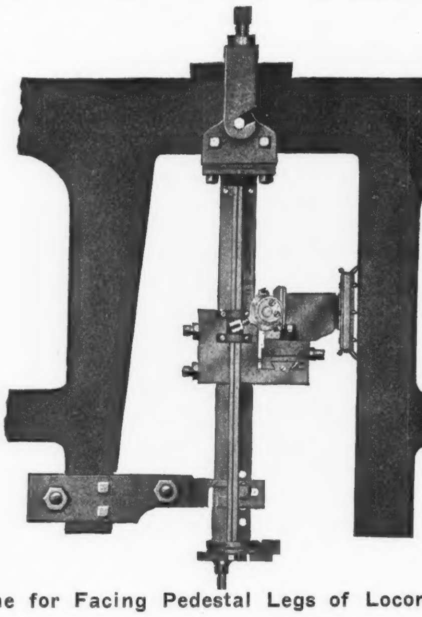
A number of Scherzer rolling lift bridges are being built for both British and Colonial railroad service. It is expected that the combination single-track railroad and highway bridge at Barrow-in-Furness, England, and the two double-track bridges for the Buenos Ayres Great Southern Railway at Buenos Ayres, Argentina, will soon be placed in service, and work is now being pushed on the long span bridge for the Burma Railways near Rangoon, India. Several bridges of the Scherzer type are in operation or under construction in Egypt, and the two railroad and highway bridges for the Tehuantepec Railway Company at Salina Cruz, Mexico, will be completed in the near future.

About fifty Scherzer bridges have been built for electric street railway and interurban service, nearly all being double or multiple track structures.

Facing Pedestal Legs of Locomotive Frames.

The illustration shows a machine for facing pedestal legs of locomotive frames. It is made by H. B. Underwood & Co., Philadelphia, Pa.

At the top of the squared bar is a steel swivel, so that the cutting tools can be placed to work on either leg. There is also a swivel to allow work to be done on the angular side of the shoe. The top of the swivel is a large surface which clamps firmly to the frame and is easily changed, so that the work can be done in narrow spaces. In one side of the squared vertical bar, or slide, for the milling head is a steel square thread feed screw. The milling head has a bronze



Machine for Facing Pedestal Legs of Locomotive Frames.

half nut, engaging the feed screw by a ratchet and pawl for change of feed. The feed is operated by an eccentric on the milling head, driving the vertical shaft. The milling head has two adjustments, to and from the leg and across the face, giving fine and quick adjustments without knocking or loosening any part. At the lower end, universal adjustable clamps hold the device rigidly to the frame.

Power is applied to gears turning the milling spindle. This is threaded to receive the milling cutters, which are made of squared high-speed steel, and are removable for grinding and adjusting. Power reaches the gears through a telescopic shaft, having universal tumbling joints at each end. By using this flexible shafting the source of power may be placed in a convenient and out-of-the-way place, and belts are eliminated.

The machine removes a large quantity of metal quickly, making light cuts, but taking only a little time for each cut. The Underwood two-cylinder air or steam motor is recommended for driving this and other portable tools.

Heating and Ventilating the Storage Battery Stations on the New York Central & Hudson River.

In the electrification of the New York Central terminal at New York, an interesting problem was the heating and ventilation of the storage battery stations at Lexington avenue, Yonkers, King's Bridge and Bronx Park. The company installing the storage batteries was willing to guarantee them for 10 years, provided the temperature was maintained at 70 deg. F. This necessitated a heating plant for cold weather and a means of cooling in warm weather, as well as proper ventilation at all times.

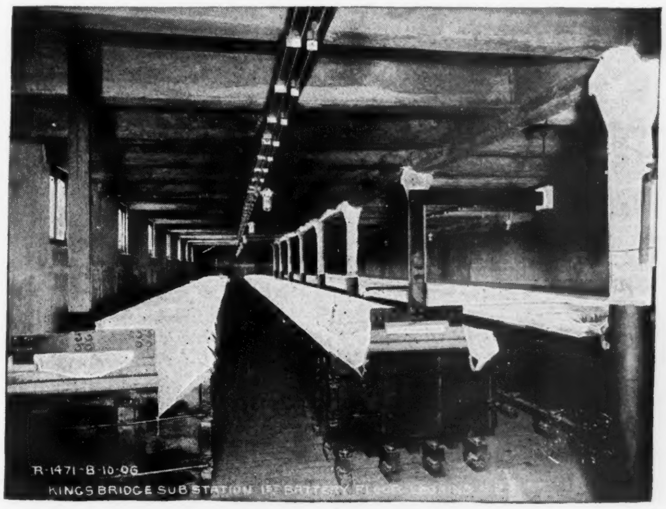


Fig. 1—Battery Floor; Kings Bridge Sub-Station.

In charging the batteries, destructive acid fumes are thrown off, which precluded the possibility of heating by direct radiation, as the fumes would attack and destroy the radiators and pipe lines. The blower system was therefore adopted. The heating plant could thus be placed in a detached building, and the air ducts to the battery building are protected against the corrosive action of the acid fumes.

So far five stations have been equipped. The battery room, busbar chambers, corridors, stair halls, controller chambers, etc., are the portions heated and ventilated. The method used for heating and ventilating the King's Bridge sub-station is typical of all stations. The air is circulated through a sectional pipe heater by a steel plate fan driven by a belted motor. Steam is supplied by a small low-pressure boiler, located in an adjacent room. The hot air is distributed by suitable ducts to various points.

Fig. 2—Battery Floor, Looking East; Yonkers Power House.

Two methods of distribution are used. These are shown in the accompanying photographs. One is by carefully protected galvanized iron ducts, as shown in Figs. 1 and 2, this being used only at Yonkers. At the others there is no piping, the air being admitted at one end of the room through tile conduits terminating at registers made of 95 per cent. lead and 5 per cent. antimony. The results have been fully as satisfactory by this method as by distributing air by ducts with branches at frequent intervals. The advantage, so far as appearance is concerned, may be seen in Fig. 3. Furthermore, the ducts are costly to install and require frequent attention to keep them in condition to resist the acid fumes.

The heating system is compact, easily accessible and under control at all times. It is claimed to be moderate in cost, easily installed and economical both in operation and maintenance. It is also very flexible, it being possible to deliver the air at any temperature without diminishing the volume. Thorough ventilation for the battery rooms is therefore assured while the batteries are being charged.

The American Blower Co., Detroit, Mich., designed the systems and furnished the apparatus, which was installed by John Hankin & Brother, heating contractors, New York.

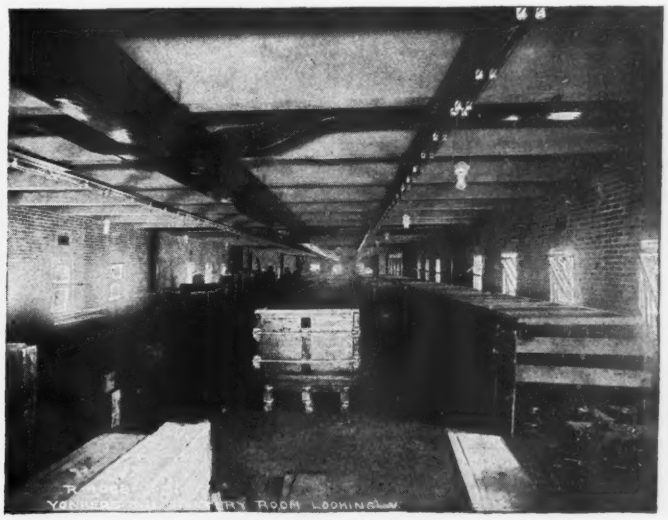


Fig. 3—Battery Floor, Looking West; Yonkers Power House.

American Iron & Steel Institute.

The American Iron & Steel Institute, formed mainly by United States Steel Corporation interests to afford a means of communication between members of the iron and steel trades, has been incorporated in New York. The Directors are: Elbert H. Gary, William E. Corey, Charles M. Schwab, E. O. S. Clarke, W. J. Filbert and John A. Topping, of New York; Howell Stackhouse and F. C. Felton, of Philadelphia, Pa.; Willis L. King, of Pittsburgh, Pa.; Edward Bailey, of Harrisburg, Pa.; J. C. Maben, of Birmingham, Ala.; W. O. Rogers, of Buffalo, N. Y.; J. F. Welborn, of Denver, Colo.; T. J. Drummond, of Montreal, Que., and Samuel Mather, of Cleveland, Ohio. The principal office is to be in New York.

A Newspaper Story.

At Homestead, Pa., Sunday afternoon the locomotive of a fast train tossed John Hastings over the roof of a (one-story) house and into the window of a shoe shop 40 ft. away. "He hadn't a broken bone, a bruise or a scratch," says the reporter. "He was conscious. Two bundles of laundry which he carried, one under each arm, were intact. He said he wanted to go home, and the doctor said he had no objection."

INTERSTATE COMMERCE COMMISSION RULINGS.

Rate on Cameras Upheld; on Motorcycles Reduced.

The Commission, opinion by Commissioner Prouty, has decided the case of Merchants Traffic Assoc. v. Atchison, Topeka & Santa Fe et al. The complaint was that the rates on cameras and camera stands from St. Louis, Mo., to Denver, Colo., and on bicycles and motorcycles are excessive. The Commission decided that while the rate on cameras and camera stands is high, it is not so excessive as to warrant interference; this branch of the complainant's case was not sustained. The rate applied on motorcycles from St. Louis to Denver was held to be excessive, and ordered to be reduced so as not to exceed the rate on bicycles between said points.

TRADE CATALOGUES.

Steam Shovel News.—The current number is a special spring number. The leading article is on "Testing High Explosives," by Waldon Fawcett. The tests referred to are those now being made by Dr. Charles E. Munroe for the United States Government. Other interesting articles are: "Transporting a Steam Shovel," describ-

ing the moving of a traction steam shovel through some heavily timbered and swamp country in Minnesota; "Steel Sheet Piling for Cofferdam Construction"; "Steam Shovel Work in the Klondike"; "A Scow for Trench Shovels"; "Stripping Ore Mines," and "Quarry Economy." There are also descriptions of some new boom and swing engines for heavy-duty shovels, and an electric shovel.

Waterproofing.—The Standard Asphalt & Rubber Co., Chicago, has prepared a pamphlet regarding its waterproofing for foundations and track elevation and other structures. The physical properties and the general method of application are first described, and this is followed by illustrated descriptions of a number of pieces of work done for railroads, large buildings, reservoirs, etc. There is also a list of similar work which has been done or is under way. Another pamphlet is a catalogue and price list of coatings and dips. An effort has been made in this to give a concise and true description of the materials and the work to which they are adapted. The book is 3⅝ in. by 6 in. and has 28 pages.

Signal Construction Materials and Lightning Arresters.—The signal department of The Railroad Supply Co., Chicago, has issued Sections 3 and 4 of Catalogue No. 7. Part 3 shows signal construction and maintenance materials, including battery chutes and receptacles, batteries and battery supplies, channel pins and bond wires, insulated joints and track insulations, insulated and line wires, and miscellaneous construction and maintenance materials. Part 4 shows various styles of lightning arresters, designed for both direct and alternating current. Various lightning arrester applications, ground plates, ground rods and water and fireproof boxes for arresters are included.

J. G. White & Co. have issued an exceedingly interesting pamphlet of 82 pages showing illustrations and brief comment upon their engineering work in every quarter of the world. The pamphlet includes a map on which 115 J. G. White contracts all over the globe are indicated by red dots. It is entitled "At Work Around the World."

London & North Western.—This company has issued a revised list of its picture post cards. There are now 55 sets of these cards, selling at 2d. per packet. Eight million cards have been sold.

Mine Equipment.—A circular issued by The Jeffrey Manufacturing Co., Columbus, Ohio, illustrates 14 of the Jeffrey specialties in mine equipment.

MANUFACTURING AND BUSINESS.

The offices and plant of the Gordon Battery Co. have been moved to Aldene-Roselle, N. J.

The offices of the General Contracting & Engineering Co., 15 Whitehall street, New York, will be moved on or about May 1 to the Hudson Terminal building, 50 Church street.

The receivership of the Westinghouse Machine Co., Pittsburgh, Pa., was vacated on March 31. The company now has no floating debt; it has a large number of orders and about $1,000,000 cash on hand.

Fred K. Potter, for many years connected with the Capell Fan Engineering Co., has been appointed Manager in the Pittsburgh district for the Sirocco Engineering Co., New York. Mr. Potter's office will be in the Keenan building, Pittsburgh, Pa.

The Railroad & Car Material Co., Bessemer building, Pittsburgh, Pa., was recently incorporated to deal in wholesale lumber, railroad equipment and supplies, including castings and forgings. The officers are: President, J. W. Scull, formerly Purchasing Agent of the Pressed Steel Car Co., Pittsburgh, Pa.; Vice-President, C. W. Cantrell, formerly Eastern Manager of the Herman H. Hettler Lumber Co., Chicago; and Secretary, W. H. Coyle.

The net profits of the Canadian Westinghouse Co., Ltd., Hamilton, Ont., for the year ended December 31, 1907, were $427,053, an increase of 23 per cent. Dividends of $215,221 were paid, $200,000 was reserved for depreciation, and $20,000 for inventory. The profit and loss balance carried forward was $391,284. At the end of the year the unfilled orders amounted to $1,136,000. The output of the air-brake department increased 35 per cent.

John C. Sesser, Engineer of Maintenance of Way of the Chicago, Burlington & Quincy at St. Louis, Mo., has resigned to go to the W. K. Kenly Co., Chicago, as Vice-President in charge of the railroad department. Mr. Sesser is a graduate of Lehigh University, having completed the engineering course in 1896. From that year until 1902 he was a construction engineer on the Chicago & North-Western, the Union Pacific and the Chicago, Milwaukee & St. Paul. From 1902 to 1903, he was Chief Engineer of the Au Sable & Northwestern, leaving that road to become Superintendent of Construction of the Burlington. In 1907 he was appointed to the office he now leaves. Mr. Sesser is a member of the Maintenance of Way Association and an associate member of the American Society of Civil Engineers. His new headquarters will be in the First National Bank building, Chicago.

The Westinghouse Electric & Manufacturing Co., Pittsburgh, Pa., has an order from the Dominion Iron & Steel Company, Halifax, N. S., for a 500-h.p. electric generator, which will be used in the operation of one of the company's iron mines on Belle Island, Newfoundland. It is interesting to note that in one of the mining camps at Guanajuata, Mex., the Pinginco mines, 250 Westinghouse motors, ranging in capacity from 5 to 200 h.p., are being operated.

A new company is being formed to take over and continue the publication of Moody's Manual, heretofore published by The Moody Corporation, New York. The manual for 1908 is now ready for the press. Arrangements are being made to supplement the book with a monthly service, thus keeping the manual up-to-date throughout the year. The price of the manual, including this monthly service, will be $10, which has heretofore been the price of the book alone.

The joint convention of the American Supply & Machinery Manufacturers' Association, the National Supply & Machinery Dealers' Association and the Southern Supply & Machinery Dealers' Association will be held at Richmond, Va., May 13-15, 1908. William H. Taft, Secretary of War, is to address the three associations on Wednesday afternoon, May 13. F. D. Mitchell, 309 Broadway, New York, is Secretary-Treasurer of the first named association.

The Quincy, Manchester, Sargent Co., New York, recently closed a competition in which prizes were offered to men in charge of track work for the best answers to certain inquiries regarding the use of, and suggestions for, anti-rail creepers. The judges of awards were as follows: W. M. Mitchell, Manager and Chief Engineer, Kentucky & Indiana Bridge & Railroad, representing the railroads; O. Metcalf, Jr., American Railway Device Co., representing the selling interests of anti-rail creepers, and W. C. McMahon, President of the Belle City Malleable Iron Co., representing the manufacturers. There were 85 competitors, and prizes were given as follows: First prize, W. H. Kofmehl, Roadmaster, Chicago, Milwaukee & St. Paul, Elgin, Ill.; second prize, W. H. Hoyt, Assistant Chief Engineer, Duluth, Missabe & Northern, Duluth, Minn.; third prize, E. J. Boland, Roadmaster, Union Pacific, Cheyenne, Wyo.

John Albert Brill, Vice-President, Director, and one of the founders of the J. G. Brill Company, Philadelphia, Pa., died on March 25, after four years' sickness. The following sketch of his life has been prepared by James Rawle, his life-long friend and President of the Brill company:

Mr. Brill was born in Philadelphia on December 15, 1852, whither his parents had moved from Cassel, Germany, a few years before. Always studious as a lad he received a sound education. At the early age of seventeen his instinct of industry led him into the works upon which he has since stamped his strong individuality and to whose building up he gave the absolute love and devotion of his life. Endowed with great ability, in which keen insight was united with infinite perseverance, he brought to the work of his life the qualities of an inventor of the most valuable improvements in transportation facilities. These embraced nearly every feature of cars and trucks which go to make up the modern electric car. At the outset of his career he did with his whole soul the things which a boy could do—drove the engine, kept the accounts. Gradually he was advanced by the firm to more responsible positions and was soon placed in charge of the department of sales. In this his great abilities found their appropriate sphere. When, in 1887, electric propulsion developed, his genius developed with it, and the present types of electric trucks in universal use are practically those which he invented. He was in every sense of the word a pioneer. He led; others followed. He foresaw by instinct, and usually years in advance, the direction in which electric street railway practice must necessarily develop, and he devoted himself to the task of teaching the railway companies. Those high in their management

John A. Brill.

recognized his wisdom and sound judgment and constantly sought his advice—sooner or later they always followed it. In 1904 the Franklin Institute awarded him the John Scott legacy premium and medal for meritorious inventions in cars. He had a strong sense of justice, but resented bitterly any treatment which he considered unfair. It is sad to see a man so strong, so worthy and so useful, stricken down by the lingering pain of disease.

MEETINGS AND ANNOUNCEMENTS.

(For dates of conventions and regular meetings of railroad conventions and engineering societies, etc., see advertising page 26.)

The Traveling Engineers' Association.

At the next regular meeting of this association there will be a paper for discussion on the "Use of Steam Heat on Passenger Trains," and at the next annual meeting a paper on "How can Road Foreman of Engines interest Engineers and Firemen in keeping posted on progress in locomotive development including valve gears and steam distribution?"

American Society of Mechanical Engineers.

The semi-annual meeting of this society is to be held in Detroit, Mich., June 23-26. The papers to be presented at this meeting are as follows: Method of Cleaning Gas Conduits, by W. D. Mount; Method of Checking Conical Pistons for Stress, by Prof. George H. Shepard; Clutches, with special reference to automobile clutches, by H. Souther; Gas Power, by Prof. L. S. Marks; Journal Friction Measuring Machine, by Henry Hess, and A By-Product Coke Oven, by W. H. Blauvelt. There will also be a symposium upon machinery for conveying materials, with papers by several authorities. The Society for the promotion of Engineering Education will also hold its annual meeting in Detroit at this time, which will enable members of each society to participate in the sessions of the other.

Iron and Steel.

The Interborough Rapid Transit is in the market for about 1,000 tons of rails of standard section.

ELECTIONS AND APPOINTMENTS.

Executive, Financial and Legal Officers.

Railway Commission of Canada.—Judge J. P. Mabee, of the High Court of Justice of Ontario, has been appointed Chief Commissioner of the Canadian Railway Commission, succeeding A. C. Killam, deceased. Mr. Mabee in 1905 was Chairman of the International Waterways Commission. His appointment to the Railway Commission is for 10 years.

Operating Officers.

Canadian Northern.—A. E. Warren has been appointed Superintendent of the Second division, with headquarters at Winnipeg, having authority over all branch lines out of that city.

Chicago, Rock Island & Pacific.—J. C. Nolan, who resigned as Superintendent of the Louisiana division in October, has been elected President, with office at Ruston, La., of the Ruston, Natchitoches & Northeastern, projected from Ruston, La., north to Farmerville, 25 miles.

Gulf, Colorado & Santa Fe.—The jurisdiction of Oliver Snyder, Superintendent of the Galveston division, has been extended to include the Southern division. The two have been consolidated and are now operated as a single division. His headquarters will be transferred from Galveston, Tex., to Temple. K. S. Hull, Superintendent at Temple, is now Superintendent of the Texas & Gulf, with office at Longview, Tex., succeeding M. T. Pratt, who returns to the engineering department of the Atchison, Topeka & Santa Fe.

International & Great Northern.—H. W. Clarke, Second Vice-President and General Manager, has been appointed General Superintendent, with office at Palestine, Tex., in charge of the whole road, reporting to the Receiver. J. C. Dailey, General Superintendent, has been appointed Superintendent, with office at Palestine, Tex., reporting to the General Superintendent. The Division Superintendents, Superintendents of Machinery, Chief Engineer, Car Accountant and General Claim Agent will report to the Superintendent.

Louisville, Henderson & St. Louis.—Lucien J. Irwin, General Freight and Passenger Agent at Louisville, Ky., has been appointed General Superintendent, succeeding A. M. McCracken, retired.

New York, Chicago & St. Louis.—G. C. Todd, Trainmaster of the Buffalo division, has been appointed Joint Superintendent of Telegraph of the New York, Chicago & St. Louis and the Western Union Telegraph Company, with headquarters at Cleveland, Ohio, succeeding R. W. Mitchener. J. W. Cantlin has been appointed Trainmaster, with headquarters at Conneaut, Ohio, succeeding Mr. Todd.

Texas & Gulf.—See Gulf, Colorado & Santa Fe.

Traffic Officers.

Cleveland, Cincinnati, Chicago & St. Louis.—Charles Krotzenberger, General Agent of the passenger department at Cincinnati, has been appointed Assistant General Passenger Agent at St. Louis, Mo., succeeding C. L. Hilleary, now General Passenger Agent of the Lake Erie & Western. W. G. Knittle, General Agent of the passenger department at Toledo, Ohio, succeeds Mr. Krotzenberger, with headquarters at Cincinnati. W. F. Carter, Traveling Passenger Agent, with headquarters at Toledo, succeeds Mr. Knittle at Toledo.

Delaware, Lackawanna & Western.—F. P. Fox, Industrial and Advertising Agent, is to resign shortly to go into other business.

Kalamazoo, Lake Shore & Chicago.—W. H. Cochrane has been appointed General Traffic Manager, with headquarters at Chicago, Ill.

Lake Erie & Western.—C. L. Hilleary, Assistant General Passenger Agent at St. Louis of the Cleveland, Cincinnati, Chicago & St. Louis, has been appointed General Passenger Agent of the Lake Erie & Western, succeeding S. D. McLeish.

New York, New Haven & Hartford.—George L. Connor, Passenger Traffic Manager, and Artemus C. Kendall, General Passenger Agent, have both at their own request retired, the former after 40 years and the latter after 41 years of service. Mr. Connor entered transportation service in August, 1868, as a clerk in the Treasurer's office of the Narragansett Steamship Co. (Bristol Line), between New York and Boston. In 1873 he was appointed Auditor of Passenger and Freight Receipts of that company, and in 1874 General Passenger Agent. After three months' service as General Passenger Agent he was appointed General Passenger Agent of the Old Colony Steamboat Co. (Fall River Line), a position which he held for 20 years. For six years of this time, beginning in 1887, he was also General Passenger and Ticket Agent of the Old Colony Railroad, until in 1893 it was absorbed by the New York, New Haven & Hartford. In 1893 he was also appointed Passenger Traffic Manager of the New York, New Haven & Hartford and shortly afterward of the Providence & Stonington Steamship Co., controlling the Sound lines to those ports. In June, 1894, his title was changed to Passenger Traffic Manager of the Old Colony Steamboat Co. On July 1, 1898, he was appointed Passenger Traffic Manager of the rail and Sound lines of the New York, New Haven & Hartford, including the New England Navigation Company, a position which he held until April 1, when he was placed on the retired list.

Mr. Kendall entered railroad service in 1861 on the Boston & Worcester, now part of the Boston & Albany, as ticket clerk at Brookline, Mass. In 1863 he was ticket clerk at Boston. In 1867 he went to the Boston, Hartford & Erie, now part of the New York, New Haven & Hartford. For three years he was Ticket Agent of this road at Boston, and for six years General Ticket Agent. In 1876 he became General Passenger and Ticket Agent of the New York & New England, now also part of the New York, New Haven & Hartford. In 1893 Mr. Kendall became General Passenger Agent of the Eastern district of the New York, New Haven & Hartford, and on July 1, 1905, General Passenger Agent of the entire road.

The office of Passenger Traffic Manager of both the New York, New Haven & Hartford and the New England Navigation Co. has been abolished. Mr. Kendall's successor as General Passenger Agent is A. B. Smith, with headquarters at Boston, Mass. Mr. Smith was born in Boston and entered railroad service in 1880 in the engineering department of the Burlington & Missouri River Railroad in Nebraska, now the western lines of the Chicago, Burlington & Quincy. After working in the engineering and operating departments he was appointed Assistant General Passenger Agent. In 1904 he went to the Northern Pacific as Assistant General Passenger Agent, and in 1907 came to the New Haven as General Traffic Manager of the Connecticut Company, which operates the extensive electric system in Connecticut of the New Haven. He has been promoted from this position to be General Passenger Agent of the New York, New Haven & Hartford and of the New England Navigation Co., in which latter position he succeeds F. C. Coley, who, besides being Assistant General Passenger Agent of the New York, New Haven & Hartford, with headquarters at New Haven, Conn., becomes Assistant General Passenger Agent of the New England Navigation Co., with headquarters at New York.

The authority of R. T. Haskins, Freight Traffic Manager of the New England Navigation Co., has been extended to repre-

sent the freight traffic interests of the N. Y., N. H. & H., at New York, including such special duties as may be assigned to him. Mr. Haskins will report to B. Campbell, Vice-President.

Pennsylvania Lines West.—M. S. Connelly, General Western and Division Agent, at Chicago, Ill., has been appointed General Freight Agent, with office at Pittsburgh, Pa., succeeding James B. Hill, deceased.

Southern Pacific.—John H. Glynn has been appointed New England Agent in charge of the passenger and freight departments, with headquarters at Boston, Mass., succeeding E. E. Currier, deceased.

Engineering and Rolling Stock Officers.

Chicago, Burlington & Quincy.—John C. Sesser, Engineer of Maintenance of Way at St. Louis, Mo., has resigned to become Vice-President of the W. K. Kenly Co., Chicago. See Manufacturing and Business.

Kansas City Southern.—F. R. Cooper has been appointed Superintendent of Machinery, with headquarters at Pittsburgh, Kan., succeeding R. M. Galbraith, resigned.

Purchasing Agents.

New York, New Haven & Hartford.—J. H. Sanford, Assistant Purchasing Agent, has been appointed Manager of Purchases and Supplies, with office at New Haven, Conn., succeeding A. E. Mitchell, resigned.

LOCOMOTIVE BUILDING.

The Lehigh & New England is said to be in the market for three locomotives. This item is not yet confirmed.

CAR BUILDING.

The Wisconsin & Northern is in the market for three passenger cars.

The Pittsburgh, Shawmut & Northern is asking bids on 1,000 coal cars.

The International Railway, Buffalo, N. Y., is said to be in the market for electric cars. This item is not yet confirmed.

The Third Avenue Railroad, New York, is said to be in the market for electric cars. This item is not yet confirmed.

The New York City Railway is said to be in the market for 150 pay-as-you-enter cars and 100 standard cars. This item is not yet confirmed.

The Oklahoma Railway Co., Oklahoma City, Okla., is said to be in the market for three interurban cars. This item is not yet confirmed.

The Lehigh & New England has ordered 250 forty-ton, all-steel gondola cars from the Cambria Steel Co., and 250 thirty-ton steel underframe box cars from the American Car & Foundry Co.

RAILROAD STRUCTURES.

Acapulco, Guerrero, Mex.—The Mexican government, it is said, has plans under way for harbor improvements here to cost several million dollars. The preliminary work includes a new wharf, for which contract has been let.

Brandon, Man.—Plans, it is said, are being made by the Canadian Northern to put up a new passenger station here.

Empalme, Sonora, Mex.—Work is now under way putting up reinforced concrete shops for the use of the Cananea, Yaqui River & Pacific and the Sonora division of the Southern Pacific here. It is said that over $1,000,000 gold is to be spent for general improvements. Plans call for the erection of 15 buildings, including a tie treating plant to have a capacity of 4,500 ties a day.

Mobridge, S. Dak.—The new steel bridge of the Chicago, Milwaukee & St. Paul, at this place, has been opened for traffic. It is said that the company will put up a new steel bridge at Chamberlain this year.

Port Bolivar.—The Santa Fe, it is said, has spent about $400,000 on improvements here, including a pier, and will spend about $100,000 more to finish the work. Port Bolivar, which is the deep water terminal of the Gulf & Interstate division of the Santa Fe, is five miles east of Galveston on the main land, is being developed into an important port by the Santa Fe. The Gulf & Interstate, which runs from Port Bolivar east to Beaumont, is also to be rehabilitated.

Pottsville, Pa.—The Pottsville Union Traction Co., it is said, will build a bridge at Mauch Chunk street.

St. Johns, N. B.—Bids, it is said, are wanted by William Downie, General Superintendent of the Atlantic division, Canadian Pacific, for the construction of concrete piers and arches for bridges at various points on the road.

Saskatoon, Sask.—The Grand Trunk Pacific and the Canadian Northern, it is said, will jointly put up a passenger station here.

Winnipeg, Man.—Bids are wanted April 15 by M. H. MacLeod, General Manager, Canadian Northern, Winnipeg, Man., for putting up a union passenger station, hotel and terminal shops, here, for the joint use of the Canadian Northern and the Grand Trunk Pacific. The estimated cost of the improvements is $3,250,000.

RAILROAD CONSTRUCTION.

New Incorporations, Surveys, Etc.

Atchison, Topeka & Santa Fe.—Excavation work has been finished on the new double-track tunnel through Raton Mountain, near Raton, N. Mex., to be 5,000 ft. long through solid rock, and 144 ft. below the existing tunnel, and the bore is being cemented. It is expected to have the tunnel in service in July. The Lantry Construction Co., of Kansas City, Mo., contractors. (March 13, p. 389.)

Birmingham & Gulf Railway & Navigation Co.—Incorporated last year in Alabama with $10,000,000 capital, to build an electric line from Tuscaloosa, Ala., northeast via Birmingham to Gadsden, about 120 miles; also to operate a line of steamers and coal barges between Tuscaloosa, Mobile and Gulf points, and Montgomery and Mobile. The company has bought the Tuscaloosa Belt Railway, a 12 mile belt line at Tuscaloosa, which is being electrified. Work is now under way on the 120 miles between Tuscaloosa & Gadsden. Henry S. Thompson, President, New York; J. A. Vandergrift, General Manager, Tuscaloosa.

Canadian Northern.—The city authorities at Winnipeg, Man., it is said, will compel this company to construct a concrete subway under Water street.

Canadian Pacific.—This company, it is said, has given a contract to Janse & MacDonald, of Maple Creek, Sask., to build a new line on the north side of the river from Lethbridge, Alb., west to McCloud, about 36 miles. The old line south of the river which has steep grades, it is said, is to be abandoned. Work is now under way on a large bridge over the Lethbridge river for the new line.

Canadian River Railroad.—See Santa Fe, Liberal & Englewood.

Chicago, Milwaukee & St. Paul.—This company is reported to be ballasting and relaying its extension from Mitchell, S. Dak., to Rapid City, the track from the Missouri west, having been originally laid on a gumbo roadbed, making it almost impossible to operate in wet weather.

Durango & Sombrerete.—Surveys are reported made by this company for a proposed line, from Durango, Durango, Mex., southeast to Sombrerete, Zacatecas, about 100 miles. It is said contracts for building the line will shortly be let. Mining interests of Sombrerete are promoting the line to provide an outlet for the ores from that section.

Grand Trunk Pacific.—Contracts for building 365 miles additional in New Brunswick, Quebec and Ontario, was recently let by the National Transcontinental Railway Commission as follows:

(1) District A. New Brunswick, from a point 58 miles west of Moncton to the crossing of the Intercolonial Railway, 39.7 miles. Grand Trunk Pacific Construction Co.

(2) From last named point to the Tobique river, N. B., 67 miles. Grand Trunk Pacific.

(3) From the last named point to 2½ miles west of Grand Falls, N. B., 31.5 miles. Willard Kitchen Co., Ltd., Fredericton, N. B.

(4) From boundary line between Quebec and New Brunswick west, 52.9 miles. M. P. & J. T. Davis.

(5) From west of Abitibi river crossing, Ontario, west 100 miles. E. F. & G. E. Farquier, Ottawa.

(6) From about 19½ miles west of the crossing of Mud river, near Lake Nepigon, east, 75 miles. E. F. & G. E. Farquier, Ottawa. (Mar. 20, p. 429.)

Foley, Welch & Stewart, who have the contract for building 126 miles from a point six miles east of Edmonton, Alb., west, have sublet some of the work as follows: Chas. Lawrence, six miles; D. Fitzgerald, 12 miles; John Timothy, eight miles; James O'Connor, 11 miles; Fitzgerald & Tompkins, five miles; F. Mann, three miles, and MacDonald & McAllister, 10 miles. Additional sub-contracts will shortly be let by H. J. Fetter, of Edmonton, Alb.

Great American.—Incorporated in South Dakota, with a capital of $15,000,000, by Wisconsin capitalists and nominal headquarters at Pierre, and office at Chicago, and at Lancaster, Wis. The proposed route is from Chicago, Ill., northwest to Winnipeg, thence west to

Medicine Hat, Alberta. The incorporators include A. J. Hyde, Thomas T. Orton, J. C. Brockert, H. L. Moses, Lancaster, Wis., and I. W. Goodner, Pierre, S. Dak.

Illinois Central.—It is announced that regular through freight traffic over the Birmingham extension will be begun on April 19.

Interlake Railroad.—Incorporated in Illinois to build a line from a point on Lake Michigan, in Cook county, Ill., northwest to Fox Lake, in Lake county, about 30 miles. The incorporators include Otto Heper, M. F. Smith, G. S. Melcher, G. H. Coney and F. A. Stuckman.

Lake Shore & Michigan Southern.—On the extension of the Pittsburgh & Lake Erie, from Youngstown, Ohio, to Lake Erie, contract was let last year by the Lake Erie & Pittsburgh to the Carter Construction Co., to build from Mill Creek Junction, near Cleveland, southeast to Kent, 26 miles. Grading and bridge construction will soon be finished. Track laying is to be started early in May and the line from Mill Creek Junction to Kent will probably be ready for operation this fall.

Manistee & North-Eastern.—Surveys are being made by this company for an extension of its eastern branch from Wexford, Mich., northeast toward Alpena.

Mexican International.—Contract is reported let to B. Corrigan, of Monterey, Mex., for building a branch coal line through the Cloete coal fields in the state of Coahuila, connecting with the main line at Sabinas. The contract also calls for building a large bridge over the Santiago Papasquiero river, on the Tepehuanes division.

Mexican Roads.—A system of railroads about 200 miles long, it is said will be built in the state of Zacatecas, Mexico, to connect the various mining districts. The state government has granted a subsidy of $2,000 per kilometer and the right of way across the public lands has also been donated. American Smelting interests headed by R. S. Towne, are reported back of the project.

New York Subways.—The New York Public Service Commission, First district, will begin advertising for bids for building the Fourth avenue subway in Brooklyn April 6. Construction of this subway was approved by the Board of Estimate on March 27. It is to run from the Brooklyn end of the Manhattan bridge under the Flatbush avenue extension to Fulton street, thence to Ashland place, thence to Fourth avenue and under Fourth avenue as far as Forty-third street, Brooklyn. The work is divided into six sections and separate contracts will be let for each section. Nothing will prevent one contractor from bidding on all six sections. The estimated cost for the six sections is about $15,000,000. Comptroller Metz opposed the resolution on the ground that the city's finances were not in condition to build the entire subway at the present time, and announces that he will refuse certification of contractors' checks accompanying bids so as to bring the matter into the courts. (March 13, p. 393.)

Northern Dakota.—An officer writes that bids are wanted April 15 for building this proposed line from Edinburg, N. Dak., on the Great Northern, north to a point near Hallson in Pembina county, thence northwest to a terminal not yet named on the Canadian boundary, in Cavalier county, about 21 miles. The work includes a 300-ft. pile trestle. Thos. D. Campbell, President and General Manager; C. H. McFarlane, Chief Engineer, Grand Forks, N. Dak. (March 13, p. 393.)

Rome & Osceola.—This company is to be incorporated to build from Rome, Oneida county, N. Y., north to Osceola, Lewis county, 25 miles. The names of the incorporators are not given.

San Diego & Arizona.—This company, which has some surveys made for its proposed line from San Diego, Cal., east to Yuma, Ariz., 200 miles, and a small amount of grading finished near San Diego, is being promoted by John D. Spreckles, of San Francisco. A concession, it is said, has been asked for by the same interests from the Mexican government to build south on the peninsula of Lower California to Magdalena bay, thence across the peninsula to the port of La Paz. It is proposed to build a line about 700 miles long.

San Juan, Taviche & Oaxaca.—This company is now owned by the Consolidated Metals Co., with headquarters at Oaxaca. It is said that the new owners have given contracts for an extension to the Taviche mining camp, in the state of Oaxaca.

Santa Fe, Liberal & Englewood.—An officer writes that work is under way at various points building this line from Des Moines, N. Mex., east via Hooker to Woodward, Okla., with a branch from Gate, Okla., northeast to Englewood, Kan., a total of 321 miles. The Canadian River Railroad, building from the proposed terminus at Woodward, southeast to Watonga, from which place there are to be two branches, one east to Guthrie and the other southeast to Oklahoma City, is to form part of this line. Very little construction work has been finished on this line.

York (Pennsylvania) Railway (Electric).—This company recently opened for traffic its new line from York Pa., southwest to Hanover, 18½ miles. Plans are reported underway for an extension from York to Harrisburg.

RAILROAD CORPORATION NEWS.

Atchison, Topeka & Santa Fe.—A semi-annual dividend of 2½ per cent. was on April 1 declared on the common stock. This is at the annual rate of 5 per cent., which is a reduction from the 6 per cent. rate, which has been paid for one year. Before April, 1907, the rate was 5 per cent., and from 1902 to 1905, 4 per cent. The first payment on the common stock was made in 1901, when a dividend of 3½ per cent. was paid.

Gross earnings for February decreased 9 per cent. as compared with February, 1907. Net earnings decreased 5½ per cent. There were 166 more miles operated in 1908 than in the previous year.

Birmingham & Gulf Railway & Navigation Co.—This company has bought the 12 miles of belt railroad, formerly owned by the Tuscaloosa Belt Railway, at Tuscaloosa, Ala. This is now being electrified and contracts have been let for a 120-mile extension to Gadsden. George D. Rogers, 42 Broadway, New York, is Secretary and Treasury. (See Railroad Construction column.)

Chicago, Cincinnati & Louisville.—The receiver has applied to the United States Court for permission to issue $1,500,000 receivers' certificates. He says that the road has never been fully completed or equipped. It needs to be reballasted, side tracks must be put in at Cincinnati and other points, the freight-house at Cincinnati must be enlarged, an overhead crossing must be built at the Big Four tracks to avoid threatened suit, an additional telegraph wire from Cincinnati to Chicago must be strung, a roundhouse and other improvements must be made at the Peru shops, a station must be built at Hammond, a station should be built at Converse, coaling stations should be put in at Richmond and at Brighton and other improvements must be made. About $500,000 to $600,000 would cover the foregoing. Furthermore, though a good passenger business is done at night between Cincinnati and Chicago in Pullman cars, the day business is bad because of the poor day coaches; $100,000 should be spent for parlor cars, café cars and day coaches. Not less than $300,000 to $400,000 worth of freight cars are also needed. There are charges against the road by other roads for handling C., C. & L. cars, which, if not paid, will result in the company's being shut off from communication with other roads. There are claims for labor, material and supplies. The receiver thinks that by using $1,500,000 it will be possible to earn not only operating expenses, but enough to meet all fixed charges and so increase the value of the property that when finally sold a price more than $1,500,000 greater than could now be obtained will be received.

Chicago Great Western.—Gross earnings for the six months ended December 31, 1907, decreased 9 per cent., as compared with 1906. Net earnings were $817,000, against $1,500,000 in 1906, a decrease of 45 per cent. There was a deficit of $360,000 after paying interest on the debenture stock and all prior charges, as against a surplus of $520,000 in 1906. Cash on deposit on December 31, 1907, amounted to $2,256, while the company's bank account had been overdrawn $109,715.

Chicago Junction Railway.—See Indiana Harbor Belt.

Chicago Union Traction.—The preferred stock has been assessed $3⅓ a share and the common stock $1 a share, payable on or before May 1, 1908. The present plan of reorganization involves cutting down the $12,000,000 preferred stock to $6,000,000 and the $20,000,000 common stock to $5,000,000.

Colorado & Southern.—Gross earnings for February were $1,083,000, against $1,027,000 in February, 1907. Net earnings were $330,000, against $314,000 in 1907. Owing to an increase of $16,700 in the interest charges, there was a decrease of $1,366 in surplus after charges.

Delaware & Hudson.—This company owns all but one share of the $4,000,000 common stock of the New York & Canada Railroad. This one share has recently been bought by Vice-President W. H. Williams for a price said to be $1,500. The Delaware & Hudson is now asking from the Public Service Commission, Second District, authority to acquire this remaining one share and to absorb the New York & Canada. The New York & Canada runs along the west side of Lake Champlain from Whitehall, N. Y., to Rouses Point, and forms a part of the Delaware & Hudson's through line to the Adirondack mountains and Montreal.

Denver & Rio Grande.—Gross earnings for February were $1,200,000, against $1,500,000 in 1907. Net earnings after taxes were $377,000, against $417,000 in 1907. For the eight months ended February 29 net earnings after taxes were $4,695,000 in 1908, against $4,636,000 in 1907.

Erie.—This company has been authorized by the Public Service Commission, Second District, to issue $15,000,000 notes dated April 1, 1908, and payable on or before July 1, 1913, secured by general lien 4 per cent. bonds to the amount of $9,457,000 and Pennsylvania collateral 4 per cent. bonds not exceeding $750,000, as collateral. These notes have not, so far as is known, been sold, although the Erie has $5,500,000 discount notes maturing on April 8, besides other pressing obligations.

Grand Trunk Pacific.—The Transcontinental Railway Commission is to buy the Temiscouta Railway for use as part of the line from Moncton, N. B., via Quebec, to Winnipeg, Man., 1,800 miles. The Temiscouta Railway runs from Riviere du Loup via Edmundston Junction to Connors, 113 miles. Only the line from Riviere du Loup to Edmundston Junction, 81 miles, will probably be used as part of the through line.

Great Northern.—The following controlled companies are now owned directly by the Great Northern:

St. Paul, Minneapolis & Manitoba	Montana & Great Northern
Eastern Railway of Minnesota	Billings & Northern
Willmar & Sioux Falls	Spokane Falls & Northern
Park Rapids & Leech Lake	Columbia & Red Mountain
Minnesota & Great Northern	Washington & Great Northern
Duluth, Watertown & Pacific	Seattle & Montana
Dakota & Great Northern	Minneapolis Union
Montana Central	

Gulf & Ship Island.—Net earnings for February were $16,000, against $65,000 in 1907, a decrease of 75 per cent.

Indiana Harbor Belt.—The report of the Chicago Junction Railway for the year ended December 31, 1907, has the following statement in regard to the sale of the outer belt line of the Chicago Junction to the Indiana Harbor Belt:

> That part of the railroad of the Chicago Junction Railway known as the "outer belt," which is the railroad originally belonging to the old Chicago, Hammond & Western, has been sold under the terms of contract dated June 29, 1907, between the Chicago Junction Railway and the Indiana Harbor Belt Railroad, the Lake Shore & Michigan Southern and the Michigan Central. The consideration received consisted of $2,500,000 bonds issued by the Indiana Harbor Belt Railroad. These bonds bear interest at the rate of 2 per cent. per annum for the first five years, 3 per cent. per annum for the second five years, and 4 per cent. per annum thereafter, and the principal is payable July 1, 1957. The bonds are guaranteed as to principal and interest by the Lake Shore & Michigan Southern and the Michigan Central. The so-called "outer belt" was subject to a mortgage executed by the old Chicago, Hammond & Western, to secure an outstanding issue of $2,500,000 6 per cent. bonds, and connected with it were contracts with other railroads which involved constant expenditures for increased trackage and facilities. This mortgage and indebtedness and the performance of these contracts were assumed by the purchasers. As the property would require the immediate expenditure of large sums for necessary betterments and improvements, and increased facilities, the sale upon the terms stated was considered highly advantageous to the Chicago Junction Railway. The result has been to relieve it from liability for the payment of the $2,500,000 of existing bonds and the fixed charge of $150,000 per annum, as well as from the necessity of providing large sums for improvements and for additional trackage under existing contracts.—(Nov. 15, 1907, p. 666.)

Leavenworth, Kansas & Western.—See Union Pacific.

Lehigh Valley.—Gross earnings for February were 10 per cent. less than in February, 1907, and net earnings 50 per cent. less. This is the worst showing which the road has made in any month of the present depression.

Louisiana & Arkansas.—Net earnings for February were 50 per cent. less than in 1907.

Metropolitan Street Railway.—See New York City Railway.

National Railways of Mexico.—On March 28 the public deed of incorporation of the new company, in which are to be merged the Mexican Central, the National of Mexico and other railroads controlled by the Mexican government, was signed by 23 incorporators, headed by Minister of Finance Limantour. (March 6, 1908, p. 330.)

New York City Railway.—Messrs. Joline & Robinson, as receivers of the Metropolitan Street Railway, has been authorized by the United States Circuit Court to issue $3,500,000 one-year 6 per cent. receivers' certificates, no part of whose proceeds may be used except in the improvement, acquisition and maintenance of the property. (March 20, 1908, p. 430.)

Kuhn, Loeb & Co. offer to pay the semi-annual interest coupon, due April 1, 1908, on those of the 4 per cent. refunding 100-year mortgage bonds of the Metropolitan Street Railway, which have been deposited subject to the bondholders' agreement, prior to May 15, 1908. This same firm took similar action in regard to the coupons defaulted January 1 on the 4 per cent. bonds of the Third Avenue Railroad.

Pacific Coast Company.—A quarterly dividend of 1¼ per cent. has been declared each on the second preferred and the common stock, making an annual rate on each of 5 per cent., instead of 6 per cent. annually, which has been paid since 1905 on each of these classes of stock. The Pacific Coast Company operates five steamship lines along the Pacific coast from Nome, Alaska, to Mexico, and also owns the Columbia & Puget Sound Railroad, about 50 miles, and the Pacific Coast Railway, with 80 miles of narrow gage line.

Pennsylvania.—Gross earnings of the Lines East, directly operated, decreased 14 per cent. in February, 1908, as compared with February, 1907. Net earnings decreased 17 per cent. For the two months ended February 29 gross decreased 15 per cent. and net 20 per cent.

Shipments of bituminous coal originating on the Pennsylvania Railroad Company's Lines East of Pittsburgh and Erie for the three months from Dec. 31, 1907, to March 28, 1908, were 8,093,033 tons, against 9,196,623 tons in 1907, a decrease of 12 per cent. The coke shipments were 1,718,252 tons, against 3,433,088 tons in 1907, a decrease of 50 per cent.

Philippine Railway.—This company controls the projected railroads on the Philippine Islands other than Luzon, the lines on that island being controlled by the Manila Railway. The Philippine Railway has 40 miles in operation on the island of Cebu and 20 miles more on that island under construction. On the island of Panay, 40 miles are under construction. Its contract with the Philippine government calls for the construction of a total of 95 miles on Cebu, 100 miles on Panay and 100 miles on Negros. The New York Stock Exchange has recently listed $1,500,000 first mortgage 4 per cent. 30-year bonds of 1937, guaranteed by the Philippine government, and has authorized the listing prior to July 1, 1908, of $1,000,000 additional of these bonds.

Reading Company.—Gross earnings of the Philadelphia & Reading in February were $2,600,000, against $3,100,000 in 1907. Net earnings were $770,000, against $889,000 in 1907.

Rock Island Company.—It is reported that plans are under way for the separation of the Chicago, Rock Island & Pacific, the Choctaw, Oklahoma & Gulf, which is the Choctaw division of the Chicago, Rock Island & Pacific, and the St. Louis & San Francisco. Strong protest against the present close combination between these roads has been made by the state authorities of Oklahoma.

Southern.—Gross earnings for February were 16 per cent. less than in 1907. Net earnings decreased 9 per cent. Taxes increased 18 per cent. and net earnings after taxes decreased 15 per cent.

Temiscouta Railway.—See Grand Trunk Pacific.

Texas Southern.—The foreclosure sale of this road, often advertised and postponed, is now set for May 5; the upset price, $375,000. The road, which runs from Winnsboro to Marshall, 74 miles, with four short branches, making a total operated mileage of 109 miles, is said to be in a chaotic state.

Third Avenue Railroad.—Frederick W. Whitridge, Receiver of the Third Avenue Railroad, and of the Forty-second Street, Manhattanville & St. Nicholas Avenue Railway, has been appointed by Judge Lacombe, of the United States Circuit Court, Receiver of the Union Railway, one of the subsidiaries of the Third Avenue Railroad. The Union Railway operates street railways in the borough of the Bronx, New York City.

Tuscaloosa Belt.—See Birmingham & Gulf Railway & Navigation Co.

Union Pacific.—A special meeting of the stockholders will be held on May 5 to ratify the taking over of the physical properties of the Leavenworth, Kansas & Western, which runs from Leavenworth, Kan., to Miltonvale, 166 miles, and has been operated separately, although all of its stock is owned by the Union Pacific; and of the Topeka & Northwestern, which is a cut-off from Menoken, Kan., to Onaga, with an extension under construction to Marysville, in all 69 miles. This cut-off is to connect Kansas City with the main line in Nebraska. The stockholders are also to authorize an issue of bonds on the (about) 1,650 miles of line of the Union Pacific now mortgaged, including the two railroads already named. This bond issue will probably be about $50,000,000, secured by a first mortgage on these lines.

The directors of the Union Pacific have denied the request of certain stockholders that they should sue E. H. Harriman, H. H. Rogers and James Stillman, directors, for personal profits alleged to have been made by them in the sale of stocks held by them to the Union Pacific, and have made the statement that the ownership of the three directors named in certain of the stocks bought during the latter half of 1906 was known to the Board, and that these directors were excused from voting on the matter of purchase; furthermore, that so far as is known by the Board, and it is so informed by Kuhn, Loeb & Co., none of these directors had any ownership in the 105,000 shares of the Illinois Central stock purchased by the Union Pacific from that firm.